

Violence against children: further evidence suggesting a relationship between burns, scalds, and the additional injuries

Dragana Seifert · Julia Krohn · Mandi Larson ·
Andrea Lambe · Klaus Püschel · Henrike Kurth

Received: 28 November 2008 / Accepted: 26 March 2009 / Published online: 28 April 2009
© Springer-Verlag 2009

Abstract Up to 22 % of all child maltreatment cases involve non-accidental burns or scalds. In the time period of 2000 until 2007, 20 children with non-accidental burns and scalds in conjunction with other mechanisms of injury were examined at children's hospitals in Hamburg and at the Institute of Legal Medicine, University Medical Center Hamburg-Eppendorf, by experts in forensic medicine. The fact that these children presented with additional injuries due to blunt and sharp force and sometimes had signs of neglect emphasize the urgent need for a multidisciplinary cooperation between pediatricians and forensic medical experts to ensure the early identification and prevention of child maltreatment. A new approach for Germany, enforcing mandatory child well-being examinations is discussed.

Keywords Child maltreatment · Non-accidental burns or scalds · Prevention · Violence against children

Introduction

Approximately 6–20% of all child abuse cases involve either scalds or burns [1–3]. This type of violence against

children occurs less often than blunt force trauma, yet appears to be more profound when it does occur [4]. Inflicted burns represent an exceptionally vicious and brutal form of violence against children. The recovery from such injuries entails not only the long-term physical sequella such as pain, but also the psychological aspect of the child coming to terms with the cruelty of such abuse. Non-accidentally inflicted burns are to be regarded as one of the most serious forms of child abuse [5].

Violence involving the infliction of burns is seldom reported as the sole form of violence perpetrated against a child [6, 7]. Frequently, a complete physical assessment of these children will yield a number of old injuries, such as fractures and scarring in various stages of healing [8]. Perpetrators, often the legal guardians of the child, are then unable to give a plausible explanation for the etiology of such injuries, and the injuries cannot be reconstructed as having been accidentally acquired. Health professionals also have to consider the child's developmental abilities when determining the reliability of the history [9]. The presence of inflicted burns correlates with the child's failure to thrive general physical neglect and, in some cases, the sexual abuse of the child [10].

Recently, Hicks and Stolfi reported that 14 % of young children with abusive burns had occult fractures [11]. This frequency is high enough to be considered clinically significant. Therefore, a skeletal survey should always be considered a part of the evaluation of any infant and young child with suspicious burns.

An in-depth analysis of the injury pattern, as well as the mechanism and localization of lesions, proves extremely important in differentiating between accidentally and non-accidentally inflicted burns. Accidental scalding generally produces a homogenous "spill or splash pattern" with circumferential low-grade burns and a poorly demarcated line

D. Seifert (✉) · J. Krohn · M. Larson · A. Lambe · K. Püschel ·
H. Kurth
Department of Legal Medicine,
University Medical Center Hamburg-Eppendorf,
Butenfeld 34,
22529 Hamburg, Germany
e-mail: d.seifert@uke.uni-hamburg.de

H. Kurth
Department of Pediatrics,
University Medical Center Hamburg-Eppendorf,
Martinistraße 52,
20246 Hamburg, Germany

of burning. On the other hand, non-accidental scalds result in injuries with uniformly distributed, partial to full thickness burns (“stocking or glove” patterned burns) [12]. In addition, contact burns which mirror the objects used to burn, such as cigarettes, heating units, and stovetops are highly suspicious of child abuse [13]. However, a differential diagnosis should be considered if the child has a history of dermatological conditions [14] or chemical skin reactions, i.e., due to phytophotodermatitis [15] or senna-based laxatives [16]. Additionally, Feldman [17] reported that dry pressure injuries caused by infant swings, cowboy boots, or elastic pajama cuffs can be mistaken for child abuse by burning.

In newborns and infants who sustain burns, a mere 5–8% of affected body surface area may lead to serious health consequences [18]. Therefore, immediate medical attention is of utmost importance for these children. Often, however, emergency medical care is delayed due to overstrained parents or guardians who may not even be aware of the seriousness of the injuries [19]. Others fear the consequences of being reported by the health care professionals. A fatal, or at a least a life-threatening situation may quickly arise for the child.

Our hypothesis is that a review of suspected cases of child abuse examined at the Institute of Legal Medicine will support the claim that non-accidental burn and scald injuries are seldom an isolated victimization

Methods

In the time period of January 2000 until December 2007, 33 children between the ages of 1 month and 13 years with suspicion of non-accidental burns were referred to the Institute of Legal Medicine and examined there or in the children’s hospitals by an expert in forensic medicine and a pediatrician. Most of children ($n=19$) were initially examined in children’s hospitals and some of them in special burn centers for children. The clinic staff were suspicious of abuse mostly due to the fact that the admitted children showed signs of other injuries and because the history given did not match the pattern of injuries.

After the initial medical care was completed, these hospitals and burn centers informed the Institute of Legal Medicine and requested an examination of the child, to determine if they were indeed victims of child abuse. The children were always examined by two physicians, one of them a specialist in forensic medicine. Only children who, concurrent to non-accidental burns, also presented with blunt and sharp force perpetrated injuries and scarring, or who exhibited obvious signs of neglect, were included in this study.

The criteria for determining that a child suffered a non-accidental scald or burn were localization of the burn,

grade, and depth of burn, a clear demarcation of the line of the burn, absence of splash marks, contact burns which mirror the objects used to burn, as well as the medical history given and the delay in seeking medical treatment. The statements of older children, who indicated that the scald or burn was not accidental, were also used as criteria.

The following criteria were used to diagnose blunt trauma: hand imprints, double tramline and/or bruises localized in face, anterior trunk, back, buttocks, and thigh. Scars and healed abrasions in body regions mentioned above were interpreted as repetitive blunt force.

The three children who sustained sharp force injuries were able to communicate how they were injured.

Bite marks were photographed with a scale, and the photographs were sent to a forensic odontologist for a second opinion.

Criteria for the diagnosis of injuries from sexual abuse were extensive bruising of labia, acute hymen laceration, and in one case, the statement of a 13-year-old girl. These examinations were performed by a gynecologist and an expert in forensic medicine simultaneously. Manifestations of neglect were poor hygiene, inadequate clothing, poor dental hygiene, and underweight.

All children admitted to in-patient care at the hospital while showing signs of bruising were tested for hematological disorders. Children additionally showing the effects of blunt trauma to the skull region were examined by an ophthalmologist, primarily to rule out retinal hemorrhage, and also had a computer tomography of the skull performed. A skeletal radiologic survey of the humerus, forearms, femur, lower legs, thorax, and pelvis was conducted for all children admitted for in-patient care younger than 2 years.

Results

Of the 28 children, 20 (71%) with non-accidental scalds and burns presented with additional evidence of maltreatment and were included in this study. Of these, ten were girls and ten were boys with an overall mean age of 6.14 years (ranging from 1 month to 13 years). In these children, we assessed 15 incidences of non-accidental burns (Fig. 1) and seven instances of non-accidental scalding. Of the children, two (case numbers 7 and 16, Table 1) presented with both burns as well as scalds, 16 children had injuries due to blunt force trauma (Fig. 2), while four children exhibited injuries consistent with sharp force trauma. Of the 20 children, three suffered from injuries sustained as a result of sexually abuse, five presented with old scarring consistent with maltreatment, and one child exhibited bite marks (Fig. 3). Additionally, three children showed signs of being physically neglected (case numbers 2, 9, and 15) (Tables 1 and 2).



Fig. 1 Burn with hair dryer on abdomen (case 12)

The back ($n=7$ injuries), upper extremities ($n=9$ injuries), and head ($n=8$ injuries) were affected most often in children who had also sustained burns or scalds as part of the maltreatment. Of the five children, each had sustained injuries to their buttocks and lower extremities and three children each to their thorax and genitals (Fig. 4). At least nine children exhibited signs of repeated blunt force



Fig. 2 Patterned bruising, hand imprint on the right thigh (case 7)

trauma; two of these children, aged 7 and 12 years, were physically and mentally disabled. There were two cases involving siblings who had been abused (cases 16 and 20, 10 and 13, Table 1). In all 20 cases of child maltreatment, the alleged perpetrator was an immediate family member.

Table 1 All cases of non-accidental burns and scalds included in this study

No.	Gender	Age	Kind of thermal injury	Additional type of maltreatment
1	m	1 month	Scald	Multiple blunt force
2	f	1 year 1 month	Burn (hot radiator)	Repetitive multiple blunt force, neglect
3	m	1 year 2 months	Scald (hot liquid)	Blunt force
4	f	1 year 6 months	Scald (hot water)	Repetitive multiple blunt force, sexual violence
5	f	1 year 7 months	Scald (hot water)	Blunt force, sexual violence
6	f	2 years	Burn (hair dryer)	Repetitive multiple blunt force
7	f	2 years 7 months	Scald (hot water) burn (cigarette)	Repetitive multiple blunt force, scarring
8	m	3 years 4 months	Burn (cigarette)	Multiple blunt force, scarring
9	f	3 years 6 months	Scald (hot water)	Bite marks and neglect
10	m	4 years	Burn (cigarette)	Repetitive multiple blunt force
11	m	5 years 2 months	Burn (cigarette)	Repetitive multiple blunt force, scarring
12	f	5 years 3 months	Contact burn (hair dryer)	Blunt force
13	m	6 years	Burn (cigarette)	Repetitive multiple blunt force
14	m	7 years 6 months	Burn (cigarette)	Sharp force
15	f	12 years	Burn (cigarette)	Neglect
16	f	12 years	Contact burn, scald (hot iron)	Repetitive multiple blunt force, sharp force
17	m	13 years	Contact burn (cigarette lighter)	Multiple blunt force, scarring
18	f	13 years	Burn (cigarette)	Sexual violence
19	m	14 years	Contact burn (glowing knife)	Multiple blunt force, scarring
20	m	14 years	Burn	Repetitive multiple blunt force, sharp force



Fig. 3 Bite marks on both legs (case 9)

Of the 33 children examined at the Institute of Legal Medicine, five showed no evidence of child maltreatment, and of these, three showed injuries due to accidental scalding, and two children presented with a bullous impetigo.

Example case studies

Case 5

A 19-month-old toddler presented with partial depth (second degree) scalding of both lower legs. A distinct line of demarcation (“waterlines”) between healthy versus scalded skin was visible at approximately the same height on both legs (Fig. 5). The specific injury pattern (stocking pattern burns and scarring) led investigators and health care professionals to suspect an immersion burn, i.e., a history of events consistent with child maltreatment. Furthermore, the child exhibited bruising of the anal and genital regions due to blunt force trauma.

Table 2 Distribution of gender and type of abuse in addition to non-accidental scalds and burns ($n=20$)

	Number of cases		
	Female	Male	Total
Blunt force trauma	7	9	16
Sharp force trauma	1	3	4
Sexual violence	3	0	3
Neglect	3	0	3
Total	10	10	20

Case 7

A 31-month-old baby girl presented with partial and full thickness (second and third degree) burns of the lower back and buttocks. A distinct circular line of demarcation was clearly recognizable. The child’s feet were uninjured. This “doughnut” patterned lesion suggested a forceful immersion of the child’s buttocks into scalding water. This child exhibited scarring from non-accidental contact burns, (i.e., cigarettes) and extensive injury patterns due to repetitive and blunt force trauma, occurring on multiple occasions. Investigators noted a spectrum of colors in apparent

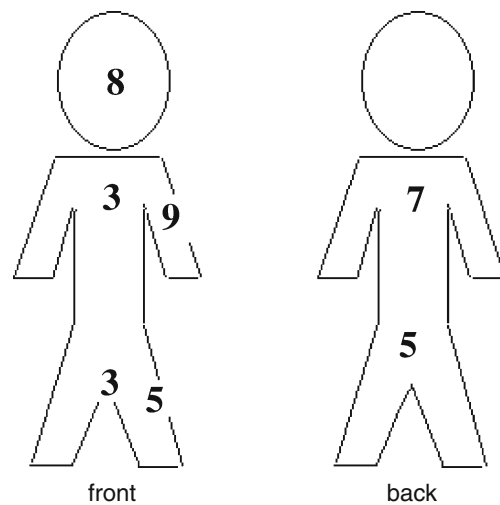


Fig. 4 Distribution of injuries due to blunt or sharp force trauma or sexual violence in addition to non-accidental burns and scalds by body parts ($n=20$ injuries, mostly more than one body part was affected: head=8, thorax=3, upper extremities=9, genitals=3, lower extremities=5, back=7, buttocks=5)



Fig. 5 a, b “Stocking” patterned scalds on both legs (case 5)

bruising and contusions on the child’s edematous face, rib cage, back, right elbow, left shin, and left thigh.

Discussion

The determination and diagnosis of accidental versus non-accidental injuries, such as inflicted burns, remains a difficult task for health care professionals. Often less distinguishable injury patterns than contact burns from a hairdryer (case 12) or stocking burns (case 4) complicate the diagnosis of child maltreatment, but the detection and diagnosis of child physical abuse depends on the clinician’s ability to recognize suspicious injuries [20]. Less experienced medical professionals tend to believe the account that parents or legal guardians give of the incident, rather than closely examining the physical evidence. As a result, many cases of child abuse remain undetected [21].

Violence against children involving scalds and burns often involves previous blunt and sharp force trauma, sexual violence, and physical or developmental neglect [22]. This was also underlined by our examinations, given that 71% (20 out of 28) of the children with non-accidental burns showed multiple mechanisms of injury. Therefore, we came to the conclusion that a non-accidental injury

mechanism, such as scalding, is not a solitary event but a form of violence employed by the perpetrator in addition to already existing forms of violence, such as blunt force trauma. Without quick identification and intervention, 35% of these children will suffer more abuse at the hands of their perpetrator [23].

Children included in our analysis had sustained multiple mechanisms of injury. However, the perpetrators only sought care for the inflicted burn injuries of their children. Most often, the associated pain and the visible severity of the burns prompted the perpetrators to seek help at a health care facility, or the injuries aroused the suspicion of third parties. The documentation of our cases showed that the threshold for inflicting burns on children appears to be lower if the perpetrator has employed blunt force trauma for an extended amount of time upon the same child given that only eight out of 28 children presented with non-accidental burns or scalds and no prior evidence of maltreatment. Our findings seem to be substantiated by research results which indicate that chronic child maltreatment is mirrored by an escalating brutality of the abuse [24]. This emphasizes the importance of a multidisciplinary cooperation (medical examiners, experts in forensic medicine, treating pediatricians, social services, child protective services, and law enforcement) to act quickly and decisively to prevent the cycle of violence from escalating. To protect children, health care professionals would need to actively search for endangered children using sensitive screening protocols as described in a study of suspected cases of child physical abuse by Martrille et al. [25]. Other children in the family should be screened for signs of maltreatment as they are at a greater risk for having sustained the same type of abuse [26].

Unlike the United States, Germany does not have a law constituting the mandatory reporting of child abuse by health care professionals. For this reason, the epidemiology of child maltreatment is largely an unexplored field. However, if substantial danger to life and limb of a child exists and can be supported by the health care professional’s assessment, information about the endangered child and the perpetrator may be passed on to the proper authorities. In January 2009, the German federal administration submitted a bill to parliament to improve the legal framework for child protection measures. If this bill is passed, professional discretion to break confidentiality—on the part of physicians and other professions bound by confidentiality rules—will be modified. Under the new law, physicians in particular will have a lower threshold to cross before notifying a child and youth protection agency, for example. If the physician discerns there is a significant potential threat to the child’s well-being and other support systems appear unable to respond adequately, it will be possible under the new law for the physician to inform the public

youth protection authorities. The new law does not, however, introduce an obligation to report perceived threats to a child to public authorities [27]. Currently in Germany, 12 preventive health examinations are proposed for children up to an age of 10 years. Of these 12 examinations, six are to be provided within the first year of life. It is up to the parents to take advantage of this schedule. One approach currently being discussed is to enforce these regularly scheduled child well-being examinations as a mandatory means of control. However, the German government recently rejected one such blueprint for this approach saying that the child's protection from abuse and neglect does not represent a health policy issue but rather a sociopolitical aspect [28].

We therefore petition for a close-knit cooperation between forensic medicine and pediatrics to provide improved and comprehensive diagnostics for children.

The limitation of our study was that we could only examine those cases that were identified by children's hospitals and burn centers. Therefore, there is the possibility that child abuse victims exist that were not properly identified and referred by the hospitals.

Conclusion

Non-accidental scalds and burns are often accompanied with additional injuries and signs of neglect. Therefore, it is necessary to assess all children with suspicious burns and scalds to identify old injuries.

Further research should be conducted at other institutes to attempt to corroborate the findings, so that further steps can be taken to integrate this information and to improve practice.

Ideally, a case conference should be considered that involves the proper authorities and where a decision can be made whether the child can be returned to legal guardians or has to remain with child protective services.

The ongoing cooperation between authorities and among health care professionals working in different sectors of our health care system will significantly aid in the prevention and identification of child maltreatment.

References

1. Renz BM, Sherman R (1992) Child abuse by scalding. *J Med Assoc Ga* 81:574–578
2. Peck MD, Priolo-Kapel D (2002) Child abuse by burning: a review of the literature and an algorithm for medical investigations. *J Trauma* 53:1013–1022
3. Hermann B (2002) Child physical abuse. Physical findings and medical diagnosis. *Monatsschr Kinderheilkd* 150:1324–1338
4. Hermann B (2005) Medizinische Diagnostik bei Kindesmisshandlungen. In: Deegener G, Körner W (eds) (Hrsg) Kindesmisshandlung und Vernachlässigung. Hogrefe, Göttingen, pp 446–465
5. Hobbs CJ (1986) When are burns not accidental? *Arch Dis Child* 61:357–361
6. Rosenberg NM, Marino D (1989) Frequency of suspected abuse/neglect in burn patients. *Pediatr Emerg Care* 5:219–221
7. Keen JH, Lendrum J, Wolman B (1975) Inflicted burns and scalds in children. *Br Med J* 4:268–269
8. Hermann B, Dettmeyer R, Banaschak S, Thyen U (2008) Hautbefunde. Kindesmisshandlung, Medizinische Diagnostik, Intervention und rechtliche Grundlagen. Springer, Berlin, Heidelberg New York, p 62
9. Allasio D, Fischer H (2005) Immersion scald burns and the ability of young children to climb into a bathtub. *Pediatrics* 115:1419–1421
10. Bennett B, Gamelli R (1998) Profile of an abused burned child. *J Burn Care Rehabil* 19:88–94
11. Hicks RA, Stolfi A (2007) Skeletal surveys in children with burns caused by child abuse. *Pediatr Emerg Care* 23:308–313
12. Oates AM, RK PJ, Spalding S, Martin H (1998) Non-accidental burns in children. *Burns* 24:552–558
13. Lenoski EF, Hunter KA (1977) Specific patterns of inflicted burn injuries. *J Trauma* 17:842–846
14. Höger H (2007) Kinderdermatologie: Differenzialdiagnostik und Therapie bei Kindern und Jugendlichen, 2. Auflage. Schattauer, Stuttgart, pp 496–501
15. Raimer BG, Raimer SS, Hebel JR (1981) Cutaneous signs of child abuse. *J Am Acad Dermatol* 5:203–212
16. Leventhal JM, Griffin D, Duncan KO, Starling S, Christian CW, Kutz T (2001) Laxative-induced dermatitis of the buttocks incorrectly suspected to be abusive burns. *Pediatrics* 107:178–179
17. Feldman KW (1995) Confusion of innocent pressure injuries with inflicted dry contact burns. *Clin Pediatr (Phila)* 34(2):114–115
18. Mücke KH, Beushausen T (2007) Verbrühung und Verbrennung im Kindesalter. *Notfall Rettungsmed* 4:184–188
19. Feldman KW, Schaller RT, Feldman JA, McMillon M (1998) Tap water scald burns in children. *Inj Prev* 4:238–242
20. Kellogg ND (2007) Committee on child abuse and neglect, evaluation of suspected child physical abuse. *Pediatrics* 119:1232–1241
21. Dubowitz H, Bennett S (2007) Physical abuse and neglect of children. *Lancet* 369:1891–1899
22. Darok M, Reischle S (2001) Burn injuries caused by a hair-dryer—an unusual case of child abuse. *Forensic Sci Int* 115:143–146
23. Skellern CY, Wood DO, Murphy A, Crawford M (2000) Non-accidental fractures in infants: risk of further abuse. *J Paediatr Child Health* 36:590–592
24. Theodore AD, Runyan DK (1999) A medical research agenda for child maltreatment: negotiating the next steps. *Pediatrics* 104:168–177
25. Martrille L, Cattaneo C, Dorandeu A, Baccino E (2006) A multicentre and prospective study of suspected cases of child physical abuse. *Int J Legal Med* 120:73–78
26. Kumar P (1984) Child abuse by thermal injury—a retrospective survey. *Burns* 10:344–348
27. Entwurf eines Gesetzes zur Verbesserung des Kinderschutzes (Kinderschutzgesetz), Bundesratsdrucksache 59/09 vom 23.01.09. www.bundesrat.de
28. Stellungnahme der Bundesregierung zu der Entschließung des Bundesrates für eine Ausweitung und Qualifizierung der Früherkennungsuntersuchungen im Sinne des Kindeswohls. Drucksache 374/07 vom 25. Mai 2007. www.bundesrat.de