The Silverman Syndrome: Identification, Evaluation and Multidisciplinary Intervention

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Abstract
This article summarizes data from a retrospective study that sought to identify and to analyze socio-demographic characteristics for 36 cases of children diagnosed with the Silverman syndrome during 2003-2017. The cases were recruited from the pediatric population admitted at the Emergency Department of "St. Mary" Children's Emergency Clinical Hospital in Iași, Romania. Approximately half of the patients were aged up to three years. 85% percent were boys. Over 80% came from rural areas. 85% of the analyzed patients were presented to the hospital without a legal representative. Of all the children referred for primary symptoms of the Silverman syndrome, 19% were considered social cases. Only one of the parents was employed in the workplace. Cases are being analyzed from the psychosocial and medical perspectives and its implications regard to the children of the clinical features of the Silverman syndrome.

Key words: Silverman syndrome, battered child syndrome, child abuse.

Résumé
Cet article résume les données d'une étude rétrospective ayant pour objectif d'identifier et d'analyser les caractéristiques sociodémographiques de 36 cas d'enfants diagnostiqués avec le syndrome de Silverman au cours de la période 2003-

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2017. Les cas ont été choisis parmi la population pédiatrique soignée au service des urgences de l'hôpital « Sfânta Maria » de Iassy. Environ la moitié des cas étaient âgés de moins de trois ans. Cinquante-huit pour cent étaient des hommes. Plus de 80% étaient issus du milieu rural. Cinquante-huit pour cent des cas examinés se sont présentés à l'hôpital sans représentant légal. Sur l'ensemble des enfants retenus pour les principaux symptômes du syndrome de Silverman, 19% étaient considérés comme des cas sociaux. Un seul des parents était actif. Les cas sont analysés du point de vue des caractéristiques sociodémographiques et médicales du syndrome de Silverman et de leurs incidences sur l'enfant.

Mots-clés : syndrome de Silverman, syndrome de l'enfant battu, abus de l'enfant.

Rezumat

Prezentul articol sumarizează date ale unui studiu retrospectiv prin care s-a urmărit identificarea şi analiza caracteristicilor socio-demografice pentru un număr de 36 de cazuri de copii diagnosticaţi cu sindromul Silverman, în perioada 2003-2017. Cazurile au fost recrutate din populaţia pediatrică admisă în Unitatea de Primire Urgenţe din cadrul Spitalului Clinic de Urgenţă pentru Copii „Sfânta Maria" din Iaşi. Aproximativ jumătate dintre cazuri au avut vârste până în trei ani. Cincizeci şi opt la sută au fost de sex masculin. Peste 80% au provenit din mediul rural. Cincizeci şi opt la sută dintre cazurile analizate s-au prezentat la spital fără reprezentant legal. Dintre toţi copiii referiţi pentru simptomele de bază ale sindromului Silverman, 19% au fost consideraţi cazuri sociale. Doar unul dintre părinţi a avut calitatea de angajat în câmpul muncii. Cazurile sunt analizate din perspectiva caracteristicilor socio-demografice şi medicale ale sindromului Silverman şi a implicaţiilor pe care această condiţie le are asupra copilului.

Cuvinte cheie: sindromul Silverman, „sindromul copilului bătut", abuz asupra copilului.

1. Introduction

In 1946, the radiologist John Patrick Caffey analyzed and described for the first time a series of children´s long bone fractures, considering that they were of unspecific origin and that certain physical trauma was the cause of subdural hematoma. In the following years, the researchers sought possible explanations and concluded that X-ray images of various fractures could expose the result of many childhood injuries suggesting parental neglect, aggressive parental behaviour or, most dramatically, indifference, immaturity and parents' irresponsibility. Studying the evolution of such cases and continuing his investigations, Caffey considered misconduct and deliberate injury as the main etiological factors associated with what he termed non-specific trauma (*apud* Pfohl, 1977).

Kempe *et al.* (1985) argued that the battered child syndrome characterizes a clinical condition in children usually up to three years of age who suffer severe physical abuse. Often, the abusive behaviour of the parent is the main cause of disability or death. In many cases, the syndrome is misdiagnosed, which is why it

is important to reassess any suspicion of non-accidental injury or child neglect (Kempe *et al.*, 1985). Emphasis has been placed on the use of X-rays in diagnosis and physicians have been advised to report all incidents to child protection services so as to reduce the risk of recidive. The significant discrepancy between clinical findings and parental explanations is one of the major diagnostic features of the battered child syndrome.

The syntagm referring to the battered child syndrome has subsequently undergone various changes and extensions in terms of diagnostic requirements. Until the 1980s, the terms of physical and/or emotional abuse, neglect, sexual abuse, or children at risk were also covered. All these inappropriate manifestations of parental behaviour concerned not only babies and toddlers but also school-age children at puberty or teenagers up to 18 years old (Parton, 2002). Until the 1960s, child abuse was viewed as a socio-medical problem in which the physicians' expertise was decisive. The concern was to correctly diagnose clinical manifestations and provide treatment to prevent the occurrence of the battered child syndrome. In time, the focus was being placed upon investigating and assessing the social causes of abusive manifestations, as well as on weighing up legal evidence, to help validate the syndrome in cases of children referred to specialized clinics.

Following Caffey's death, american pediatrician and radiologist F.N. Silverman alerted the medical community and the general public against physical abuse of the children by publishing two landmark articles in the American Journal of Radiology in 1953 (*The roentgen manifestations of unrecognized skeletal trauma in infants*) and, together with C. Henry Kempe (who is considered to have coined the syndrome's name), in the Journal of the American Medical Association in 1962 (*The battered-child syndrome*), respectively. The Silverman syndrome, nowadays also known as "the battered child syndrome", is documented based on radiological evidence of multiple untreated bone fractures occurring at various ages as a result of physical maltreatment. Typically suspicious clinical signs such as hematomas, bruises, skin lesions or burns draw the physicians' attention and a skeletal X-ray is conducted to reveal the presence of multiple bone fractures. According to epidemiological data in the United States, the incidence of the Silverman syndrome was 9.1 cases/1,000 children, while the mortality rate was 2.36 deaths/100,000 children (World Health Organization, 2016).

Since this syndrome is believed to affect about 40% of the pediatric population, which is most vulnerable, recognition of characteristic signs is paramount for avoiding serious long-term consequences. Thus, when examining a child, several elements can evoke physical violence: hematomas of various ages and unusual topography (on the face, ears, back etc.), various injuries, burns (e.g. rounded forms suggesting cigarette burns), bites, snapped hair etc. Sometimes, abuse is revealed by severe neurological disorders (seizures, hypotonia), especially in babies (the so-called "shaken baby syndrome"). Often, in such cases clinical

examinations of the external genitalia and the anal region are performed to cover sexual abuse as well (Kellogg, 2007, Kempe *et al.*, 1985).

In the opinion of Romanian specialists, Silverman's syndrome consists of the repetitive and diverse aggression of defenceless children, most often exerted by the parents (Goţia, 1993). In such cases, the physician's attribute may include: a) reporting of suspected abuses; b) consistent assessment of the child's somatic and motor development as well as of the clinically identified lesions; c) identification and evaluation of etiological factors; d) coordinating his interventions with those of other professionals, in order to provide immediate treatment and e) the long-term follow-up of the clinical evolution of the victimized children. From a psycho-social and medical perspective, accurate and timely diagnosis of children suspected of being victimized by severe and repeated physical abuse can ensure comprehensive investigation, correct assessment and positive results for the abused children and their families.

The actions carried out by the specialized medical staff when a child reaches the emergency department of a pediatric hospital include: a) resuscitation (whenever required by the patient‘s clinical condition); b) specific clinical examination for patients presenting physical trauma; c) photographing of injuries to document forensic shreds of evidence that are to be included in the file that will subsequently be initiated by social network specialists; d) notifying the hospital’s social worker and/or child protection as well as legal authorities; e) hospitalization of the minor for his immediate protection and/or therapeutic intervention. Subsequent interventions include imagistic investigations to confirm the initial diagnosis or blood tests for differential diagnosis (e.g. for documenting blood clotting disorders, which may explain inclusive cerebral hematomas). It has been estimated that 1.3% to 15% of the injuries of the children presenting at a hospital emergency department are caused by severe physical abuse (Pless *et al.*, 1987).

An important aspect of the investigations consists in interviewing parents and/or relevant persons (e.g. relatives, family doctors, social workers, etc.) about the causes that led to the current clinical condition of the minor. Physicians should be aware that explanations referring to intentional trauma highlighted by the clinical examination may be absent, vague, contradictory or misleading, key details being dramatically altered. Also, they may not match the child’s age or physical and psycho-emotional development (Kellogg, 2007).

Detailed information should be collected in a non-accountable manner in the context of etiopathogenic and social investigations. Useful information in the medical and psycho-social assessment of suspected physical abuse also include significant medical history, heredocolateral antecedents (particular bone, metabolic or genetic disorders in the minor's family), pregnancy history, abusive family patterns, history of abuse experiences (including substance abuse) impacting the development of the minor or his/her relatives, temperamental and developmental history or other contributive stressors (Kellogg, 2007).

2. Methodology

Two sources were considered in the process of identifying the children and adolescents who had been diagnosed with the Silverman's syndrome: the electronic database of the patients admitted to the "St. Mary" Children's Emergency Clinical Hospital in Iasi and the examination files filled in by the institution's Emergency Receiving Unit. Data were processed with the Microsoft Excel application.

3. Data analysis and findings

In a lengthy interval spanning over 15 years (2003-2017), a number of 36 patients admitted at the "St. Mary" Children's Emergency Clinical Hospital in Iasi, Romania, were positively diagnosed with the Silverman syndrome. 21 of them (58%) were boys. Children's age when admitted to the emergency receiving unit ranged from under 1 (7 cases) to 18 years. Most cases involved toddlers (10) and kindergarten kids (9). There were 5 cases of school-age kids, while the other five's age spanned from puberty to adolescence (10 to 18 years). 29 children (80.5%) came from rural areas, while 7 of the cases involved children of urban upbringing.

The classical triad of lesions encountered in cases diagnosed with Silverman's syndrome includes subdural bleeding, retinal bleeding and diffuse cerebral lesions that may or may not add to trunk bruises, fracture of the ribs (posterior side mainly) or metaphysis fractures of the long bones. The range of injuries encountered in literature may also include various other skin, bone or visceral lesions.

Data regarding the lesions encountered in the Silverman Syndrome cases we studied and concerning the parental status of the respective children are summarized in Tables 1 & 2.

Table 1. Lesions encountered in the Silverman Syndrome cases

Type of lesions	No. of lesions
Abdominal contusion	2
Chest contusion	6
Hand fracture	2
Leg fracture	6
Parietal fracture	2
Craniocerebral trauma	16
Bruisses	10
Bite marks	2
Excoriated skin	10
Scars	2
Polytrauma	1

Besides subdural bleeding, retinal bleeding and diffuse cerebral lesions, lesions associated with the Silverman syndrome include contusions, sprains, fractures (typical: spiral on long bones, metaphysis fractures), visceral lesions

(brain, abdomen, eye, etc.) or dental fractures. Table 1 highlights that the most common lesions identified in our 36 patients were craniocerebral traumas (acute and chronic intracranial hematoma), bruises and excised wounds, along with fractures and chest contusions. We noticed as a peculiarity that all lower limb fractures were found in children under 1 year of age. Tragically, one of the children died as a result of multiple injuries suffered.

Table 2. Parental status in the analyzed Silverman syndrome cases

Maternal status			**Paternal status**				
Housewife	Left abroad	Lack of data	Unem-ployed	Agricul-turer	Army staff	Deceased	Lack of data
20 (55%)	4 (11%)	12 (34%)	14 (36%)	5 (13%)	1 (3%)	1 (3%)	15 (44%)

Parents' occupation is an important variable in analyzing the factors that lead to or favour the occurrence of an abusive event. This aspect must be correlated with the risk of chronic material problems and certain living standards, including housing comfort. With genuine concern, it can be noticed from Table 1 that just one parent out of all those linked to cases of extremely serious physical abuse had a stable job. The very low occupational status of the parents involved (55% housewife-mothers, 36% jobless fathers) could be explained by the fact that the study sample included children coming mainly from rural areas where one's possibilities of insertion in the labour market are much lower. At the same time, the high percentage of housewives could be explained by the larger number of children in the analyzed rural families compared to the urban ones. According to the latest national data, the low educational level of the parents hamper their access to the labor market (Neagu, 2015).

The scarceness of data regarding the fathers' occupation for many of the children under consideration can be explained by the high number of natural fathers that were either unknown or have abandoned their families many years ago. On the other hand, when admitted to the Emergency Department, parents are not requested to declare their profession or current job status.

Other diagnoses associated (comorbidities) with the Silverman syndrome were: chronic hepatitis, microcephaly, interstitial pneumonia and anaemic syndrome. 7 of the 36 children were mentioned in the Emergency Department files as „social cases"[4].

3.1. Socio-demographic characteristics of children diagnosed with the Silverman syndrome

The age distribution of the children diagnosed with the Silverman syndrome (Figure 1) revealed a prevalence of 1-3 years (28%) and 4-6 years (25%) children. A

[4] A social case is one identified and registered by a professional as requiring specialized intervention of a social or child protection service (according to the National Anti-drug Agency, 2011; Dan, Lixandru and Alpozan, 2018).

fairly high percentage (19%) was noted for babies less than one year of age. In the US the last group presents the highest rate of victimization through severe physical abuse resulting in somato-neurovegetative sequelae, i.e. 25.3 cases per 1,000 children of the same age of the national population (see US Department of Health & Human Services Administration for Children and Families Administration on Children, Youth and Families, 2017).

Almost half (47%) of our retrospectively investigated cases involved babies and toddlers, categories most susceptible to present the battered child syndrome. The percentage of 7-9 years old children (14%) equaled that of the elder categories (10 to 18 years), half the figures recorded by toddlers, as shown in Figure 1.

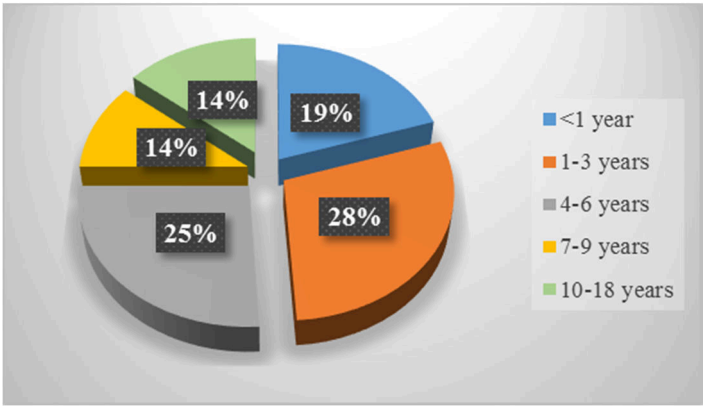

Figure 1. Age distribution of children diagnosed with the Silverman syndrome

As highlighted in Figure 2, boys experienced more recurrent episodes of abuse than the girls (58% *vs.* 42%). A rather debatable argument may be that young girls may be shyer and boys braver / more arrogant, hence more susceptible to arousing the adult's anger.

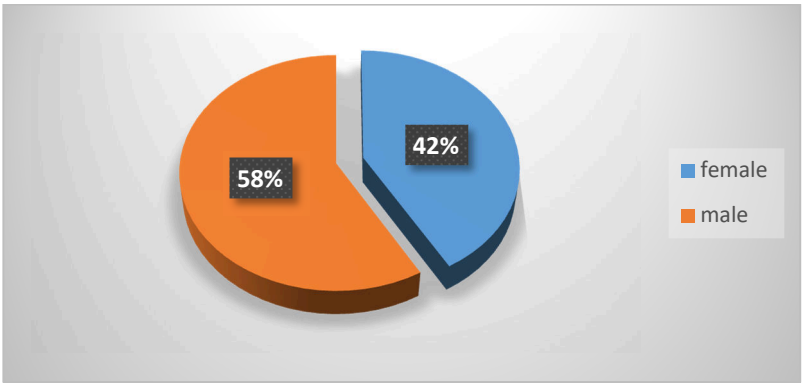

Figure 2. Sex distribution of children diagnosed with the Silverman syndrome

In our study, most children diagnosed with the Silverman syndrome originated from rural areas. A possible explanation for such disproportion is the lack of social services and tertiary prevention programs of child abuse in rural areas, due to the insufficient number of specialists able to provide continuous and careful monitoring of the situation of vulnerable families there. Figure 3 reflects the areal distribution of the sample.

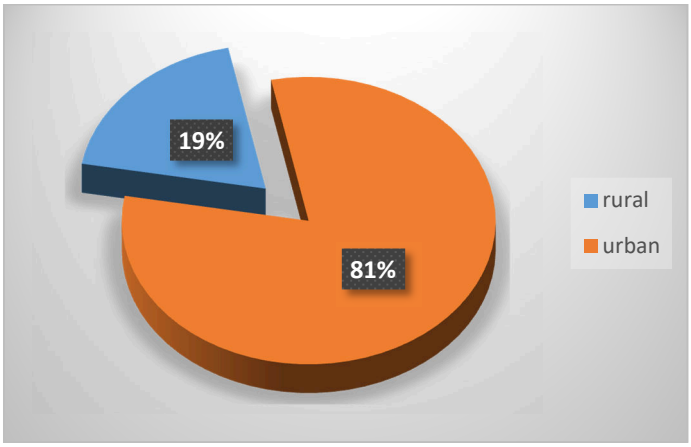

Figure 3. Distribution of children diagnosed with the Silverman syndrome according to upbringing background

Figure 4 reveals that many of the minors were brought to the hospital without their legal representatives (58%) or were, some of them being accompanied by community social workers or representatives of the General Directorate for Social Assistance and Child Protection (17%). Parental absence may be attributed to the large distance they had to travel from home, as some of them originated from other counties of the North-East region: three each from Bacău and Vaslui counties, two from Neamț, one each from Botoșani and Suceava. Some of them were brought in by helicopter, where the parental presence is excluded. On the other hand, some parents refuse to accompany terrestrial ambulance transport crews because they are under the influence of alcoholic beverages or they find different reasons, such as having to take care of other children in the family.

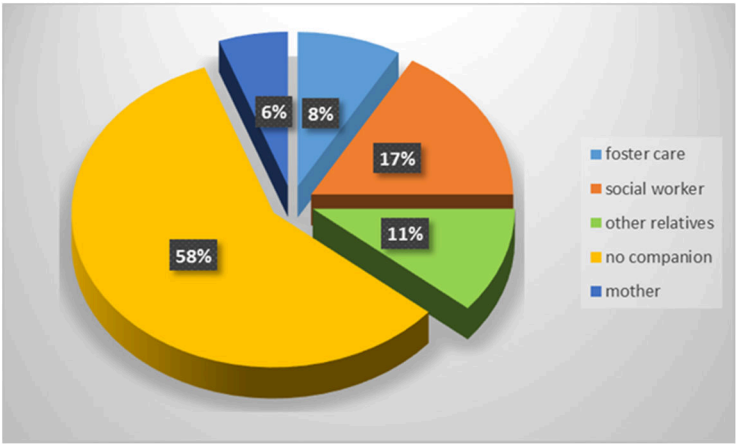

Figure 4. Distribution of cases according to the persons who accompanied the children to the hospital

4. Some discussions

The battered child syndrome is most often diagnosed by an emergency unit physician or a pediatrician. Often during the specialist examination, the child looks withdrawn, exhibiting an anxious or indifferent behaviour. The clinical examination may highlight traumatic signs of different age. The subsequent imaging tests consist of bone radiographs for fractures, computer tomography for hematomas or internal organ rupture and magnetic resonance imaging for multiple lesions at different healing stages.

Children diagnosed with the Silverman syndrome that present head or abdominal injuries are more likely to die or retain serious disabilities than those whose similar injuries were the result of an accident (Reece, Sege, 2000). Careful medical evaluation, detection of suspicious lesions and reporting of abuse can prevent further trauma in both children and adults. In a study on babies under two years of age victims of child abuse, it was found that 75% of them presented signs of previous trauma or had medical records documenting various injuries (Ricci *et al.*, 2003). 31% of the subjects admitted to the hospital with head injuries due to abuse in a sample of 173 children aged less than 3 years presented nonspecific clinical signs and were initially undiagnosed. The average time to correct the initial diagnosis among these children was 7 days. Such studies advise physicians to be aware of the possibility of abuse when assessing children exhibiting accidental injuries or obscure symptoms suggesting traumatic etiologies even if they have no trauma previously reported (Jenny *et al.*, 1999). In the absence of adequate detection and specialized intervention, child abuse recurrence rate is 35% (Skellern *et al.*, 2000).

5. Conclusions

Old habits die hard. The Silverman syndrome did not become extinct 50 years after its introduction and medical definition. Only 36 cases have been documented in 15 years, which make it under-diagnosed considering the average of admissions at the "St. Mary´s" Children Emergency Department in Iasi is 40,000 cases per year. The incidence of cases is approximately 1%, with a peak in the age group of 1-3 years.

Among the peculiarities of the Silverman also known as battered child syndrome identified in this study, we can mention traumas of different types and age, the children being brought to the hospital by people not involved in the abuse or late presentation to the emergency unit.

Child abuse is a public health issue that requires a multidisciplinary and inter-institutional approach, personal engagement and investment on behalf of all specialists so that their collaboration is centred on the child's rights, needs and interests. Collaboration and harmonization become essential, more so when being aware of the overwhelming impact of abuse and neglect on the child's physical and psychological development (social and emotional difficulties, mental disorders, etc.).

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