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Research Article

Epidemiology of Firearm Trauma in Pediatric Population at Dr. Sótero del Río Hospital

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Abstract

Introduction: Gunshot Wounds (GW) in pediatrics are rare, but increasing through the years worldwide. There are few studies that recognize the incidence of this wound in pediatric population. In Chile, there are no studies that report frequency neither severity. The aim of this study is to describe the characteristics of firearm wounds, morbidity, mortality and risk factors associated, at the Dr. Sotero del Rio Healthcare Complex.

Methods: A descriptive and analytical retrospective study, including all consultations for firearm wounds at the pediatric emergency service of the Dr. Sótero del Río Hospital during the period between 2006 to 2017, searching for 17 key terms in the electronic system of patients registration. Then it was used the reference population for southeast metropolitan health service, to calculate the incidence; and analysed morbidity and mortality aspects.

Results: The 240 patients were collected. The incidence of injuries due to firearms was 1.48 cases per 100,000 children, 1.7% patients died, but high incidence of morbidity. The categorization and prognosis on admission showed a significant association with the death outcome.

Discussion: The frequency of firearm injuries in the pediatric population has shown a decrease over time in the southeast metropolitan health service, in the period studied, but in all studies reviewed worldwide the incidence is increasing, and the majority of them are managed by a pediatric surgeon. So it is an increasing problem, that there is few literature in pediatric population that we should be aware of.

Keywords: Gunshot wounds; Firearms; Pediatric wounds; Trauma; Injury

Abbreviations

GW: Gunshot Wounds; SSMSO: Southeast Metropolitan Health Service; CDC: Center for Disease Control; APSA: American Pediatric Surgery Association; ICU: Intensive Care Unit; RBC: Red Blood Cells

Introduction

Gunshot Wounds (GW) in pediatrics are rare, but have great consequences for both: patient and health service. Worldwide, there are few studies that describe the epidemiological characteristics of affected pediatric patients, but in most of them an exact incidence is not determined.

The United States is the country that leads in statistics, so they have the largest number of published studies related to GW. The Center for Disease Control (CDC) in 2013 reported a total of 15,901 non-fatal firearm injuries in children under the age of 19 and an incidence of firearm-related deaths of 3 per 100,000 for the same population. In 2019, the American Pediatric Surgery Association (APSA) published a study establishing that GW are the second cause of death in pediatric patients [1]. Another study, published in the New England Journal of Medicine that describes the main causes of death in pediatric patients in the United States, also agrees that GW are the second cause of death and also, determine that this is one of the few causes of death that has increased its incidence in the last years.

Unfortunately, in Chile we do not have population studies that report the frequency and severity of these injuries. The aim of this study is to describe the frequency and characteristics of attacks with firearms and their morbidity and mortality in the Dr. Sotero del Rio Healthcare Complex, and to analyze the existence of risk factors associated with them.

Materials and Methods

A descriptive and analytical retrospective study was carried out, including all consultations for firearm wounds at the pediatric emergency service of the Dr. Sótero del Río Hospital during the period between 2006 to 2017. This period of time was selected since in 2006 the use of electronic records was established in the emergency department. In this electronic system, coincidences were sought between the text fields corresponding to "Symptoms", "Clinical History", "Physical Examination" and "Diagnosis" registered in the emergency care data; with 17 key terms (pellet, dagger, stab, stabbing, assault, assailant, shotgun, rifle, revolver, weapon, military, police, pistol, knife, penetrating, bullet, fire) and its derivatives. All matches were then checked against the case definition. Firearm wounds were defined as an injury caused by a projectile fired from a pistol, rifle, pellet, shotgun or blank weapon, regardless of its intention, to patients between 0 to 15 years and 11 months. Patients who were admitted directly to surgery or to the Intensive Care Unit (ICU), without

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registration in the emergency department, were also included. All admissions and surgical interventions were considered up to the first year after the injury. The population older than 16 years, consultations for old injuries and repeated consultations for the same injury were excluded.

All the electronic and physical records of the cases were reviewed, recording the following: date, day of the week, time, age, gender of the patients, referral area (surgery, trauma, neurosurgery), status of the patient upon admission, categorization, prognosis, destination at discharge (home, hospitalized), place where the event occurred, aggressor, type of weapon, characteristics (single or multiple), location of the injury, days of hospitalization, need for surgery and number of these, need for intensive care, orotracheal intubation, transfusion and death.

The reference population for the Southeast Metropolitan Health Service (SSMSO) was used to calculate the incidence. The morbidity aspects to be analyzed were: death, hospitalization, surgery requirement, number of surgeries, admission to the ICU, intubation and transfusion requirement. Possible variables associated with the results were considered: demographic characteristics of the patients; day, time, and place of injury; type of weapon; region of the compromised body and the categorization of the case upon admission.

SPSS version 23 and Stata/SE 12.0 for MAC were used for statistical analysis. Shapiro Wilks distribution test was performed for continuous variables, and according to the result of this, a non-parametric Kruskal Wallis test and Spearman's correlation were performed when appropriate. The chi-square test was used for the analysis of categorical variables and logistic regression for continuous and dichotomous variables. A p-value <0.05 was considered as statistical significance. This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

Results

A total of 240 patients with firearm injuries were identified in this period. On average there were 20 cases for each year studied. The absolute frequency of reported cases decreased during the study period from 26.6 cases per year in the first quartile, to 12.6 cases per year in the last quartile of time. The relative frequency of injuries, compared with the total number of visits to the emergency department in this period was 20.9 cases per 100,000 visits, showing a decrease over time, as shown in Figure 1. The incidence of injuries due to firearms was 1.48 cases per 100,000 children, which also decreased throughout the study period (Figure 2).

Eighty-two percent (197/240) of the patients were men, and the median age was 13.1 years (interquartile range 9.7-14.3).

The type of weapon was consigned in 191/240 (79.6%) cases, of which the most frequent was by pistol in 101 cases (53%), shotgun in 29%, rifle in 16% and blank in 2%. Eighty-five percent of the injuries occurred outside the school day, with the time between 4:00 PM and 11:00 PM being the one with the highest incidence (126/240 cases, 53%). Regarding the days of the week, 53% (128 cases) of the patients consulted between Friday and Sunday (Figure 3). The place where the accident occurred was registered in only 54/240 cases, the most frequent being: public thoroughfare (15%), patient's home (5%) and sports club (2%). Only 1 patient was injured on school grounds.

Ninety-one percent of the injuries were unique and the most

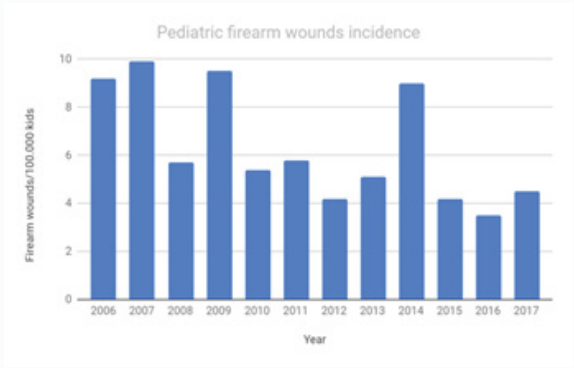

Figure 1: Shows the relative frequency of visits at the emergency department for injuries due to firearms during each year of the period studied.

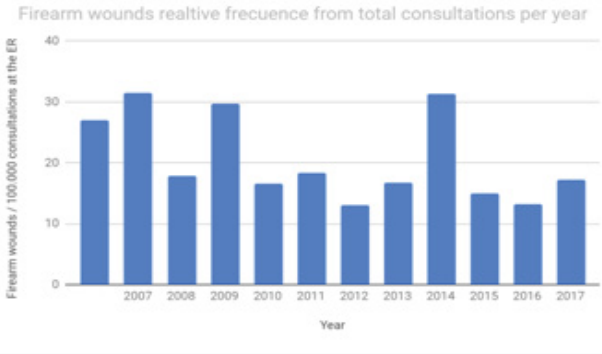

Figure 2: Shows the incidence of firearm injuries each year during the period studied.

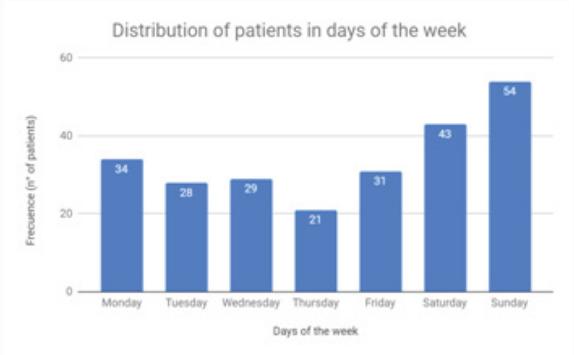

Figure 3: Shows the distribution of inquiries for firearm injuries through the days of the week.

frequently affected areas of the body were: lower limbs 94 cases (39%), craniofacial region 43 cases (18%) and in upper limbs 41 cases (17%), as evidenced in Figure 4, all of these injuries were unique. Regarding the aggressor, this was recorded only in 38/240 cases (16%), the most frequent being: unknown (50%), the same patient (36.2% both intentionally and accidentally after handling a firearm) and known (13.2%).

Of all the patients, 79.6% were referred in the first instance for management by a surgical team, 15.4% by neurosurgery, and 5% by trauma. Regarding the categorization of injuries, 123/240 was

recorded according to severity, of which 42% of these were classified as C2 upon admission and 39% C3 (Figure 5). The 59% were classified as mild prognosis.

Thirty-eight percent of the patients (92/240) were hospitalized with a median of 5 days (interquartile range 3 to 10 days). The classification variables at admission were the only ones to present a statistically significant association with the hospitalization variable.

Of the hospitalized patients, 21.7% (20/92) were admitted to the ICU for a median of 4 days (interquartile range 1.5-4 days). The age of the patients hospitalized in the ICU was significantly lower than the age of the patients who did not require ICU (median 8.7 *vs.* 14 years); with a logistic regression coefficient of -0.20 (95% confidence interval 0.7-0.9). A statistically significant association was also evidenced between the region of the body compromised with admission to the ICU: almost half (8/20) of the patients hospitalized in the ICU had craniofacial injuries, 5 patients had thoracic injuries, 4 abdominal injuries and 2 patients had multiple injuries. None of the patients with compromised limbs, neither upper nor lower, required a stay in the ICU.

Invasive mechanical ventilation was used in 13 patients, who were intubated in a median of 3 days (interquartile range 1 to 5 days). The difference between the median age of the patients who required intubation and those who did not, was also significant (8.6 years *vs.* 14 years), with a regression coefficient of -0.19. The patients who required mechanical ventilation had craniofacial (5), thoracic (3) and abdominal (4) injuries, with a significantly different distribution from the group of patients who did not require intubation.

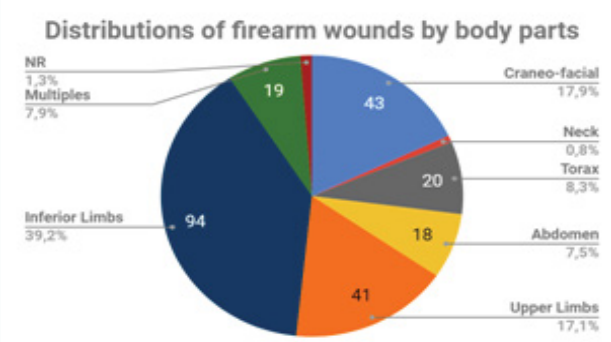

Figure 4: Shows the different body parts affected and their frequency in percentage of all injuries. *NR=Not Registered.

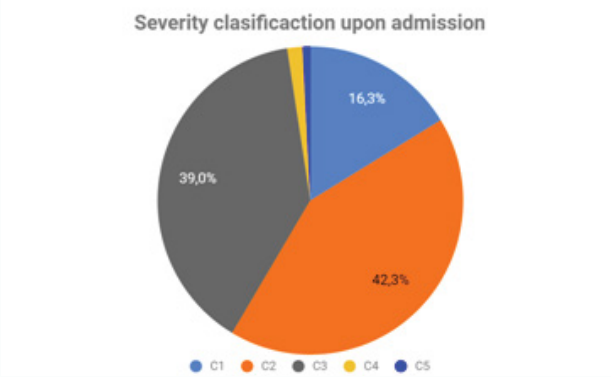

Figure 5: Shows the severity of the patients upon admission to the emergency service cataloged in the patient prioritization scale, understood by C1: Severe with vital urgency; C2: Medium severity, medical emergency; C3: Less serious, relative medical emergency; C4: Mild, medical emergency; C5: Not urgent, general medical attention.

Nine patients required transfusion of Red Blood Cells (RBC), in only 8 the amount was recorded, who on average needed 3.3 Units of RBC. The variables with a statistically significant association with transfusion were compromised body region and categorization on admission.

In 23% (55/240) of the cases, surgery was performed; 45 cases were single interventions and 10 patients required two or more surgeries. There was a statistically significant difference in the frequency of the type of weapon involved in the cases that required surgery compared to those that did not. Gun injuries represented 84% of cases with a consigned weapon that required surgical intervention and 40% of patients who were not operated (Table 1).

Four patients (1.7%) died. All were men, all required surgery, were hospitalized in the ICU and three of them required intubation. There was a statistically significant association between the regions of the body compromised with the death of the patient; three patients had craniofacial injuries and one patient had multiple injuries, as shown in Table 2. The statistical analysis failed to show a significant association between the demographic characteristics, place and time of the accident with the death outcome. The categorization (C1) and prognosis on admission (severe) showed a significant association with the death outcome.

Table 1: Shows the distribution of patients with gunshot wounds according to type of weapon and need for surgery.

Surgery	Weapon type				Total
	Gun	Shotgun	Rifle	Fogueo	
No	55	50	28	4	137
Yes	38	5	2	0	45
Total	93	55	30	4	182

Table 2: It shows the patients who died from a firearm injury during the period studied and their characteristics.

Gender	Age (years)	Region of the body affected	Surgery	Hospital stay (days)
Male	8	Craniofacial	YES	*
Male	11	Multiple	YES	8
Male	15	Craniofacial	YES	5
Male	3	Craniofacial	YES	*

(*) They died on the same day of hospital admission.

Discussion

The frequency of firearm injuries in the pediatric population has shown a decrease over time in SSMSO in the period studied. This work shows that firearm injuries are an important source of morbidity: 38% hospitalization, 71% surgery, 34% ICU, 17% mechanical ventilation. Craniofacial injuries appear to be a risk factor for mortality. Since 85% of the cases were outside of school hours, and 40% occurred on weekends, the school period seems to be a protective factor against this type of injury. The calculated incidence of these injuries was 1.48 per 100,000 cases per year, which is much lower compared to the US (8.87 per 100,000 cases) [2]. Mortality in the population studied reached 1.7%.

On the other hand, the categorization tools used in the emergency department are a predictor of outcomes, both for hospitalization,

duration of hospitalization and severity of the patient. In this way, it allows to have an advance prediction of the evolution of patients admitted as "Serious", which is a useful tool to inform parents, allocate resources and adapt care from the patient's admission.

All the studies reviewed record an increase in injuries over time [3-5]. Regarding this, possible confounding variants were analyzed such as: fewer consultations and fewer pediatric populations over time, which were discarded. The lower frequency of injuries in our registry could be explained by the opening of other emergency services in the SSMSO, or by the decrease in the pediatric population there. This is why we calculate the frequency, indexing the number of total consultations to the emergency department and the pediatric population of the service; observing the same trend. Hence it is possible that the GW frequency has actually decreased. There are several studies of firearm injuries, however, most of them are focused on describing the mortality of patients and not so much the morbidity and hospital burden of patients with firearm wounds, and into a lesser extent, describe them in the pediatric population.

A study carried out by Naghavi et al. [5] collected information on deaths from GW in patients of all ages, between 1990 to 2016 in 195 countries around the world, among which Chile is present. In this study, they estimated that, in the period studied, 251,000 firearm deaths occurred, of which 50.5% of the deaths were in 6 countries: Brazil, the United States, Mexico, Colombia, Venezuela and Guatemala; the majority were homicides, and more frequently in men. In this study, Chile reported 738 deaths in 1990 and 495 deaths in 2016.

In the United States, a study by Leventhal et al. [6] describes firearm injuries during 2009, nationwide, with a total of 7391 patients under 20 years of age, of which 1100 cases were in children under 15 years of age. They obtained a mortality associated with this type of injury of 6.1%, being the most frequent cause of these assaults (61.7%) and the most infrequent suicide attempt (3.7%). In our series, although there is a significant underreporting of the cause of the injury (38/240), in 36.8% (14/38) of the cases with registration the aggressor was the same patient; however, it is not specified whether it is suicidal or accidental.

In the UK, GWs reach 0.057 per 100,000 children [3]. In Honduras, a study reported a 4.1% prevalence of adolescents injured by firearms [7]. In addition, it has been described that patients injured by firearms have a higher risk of mortality at 5 years, mainly due to homicides [8].

In South America, Brazil conducted a retrospective study of trauma-related deaths in patients under 18 years of age, between 2001 to 2008 [9]. Autopsies were performed for the analysis of deaths, of which it was obtained that the majority were men (3.4:1), a higher percentage in adolescents between 10 to 17 years (76%), and the most frequent cause was due to gunshot wound (47%), of which 68% occurred in patients between 14 to 17 years old. They also, like our series, found that GW deaths decreased over time since 2004, which they attribute to a statute to decrease gun ownership that was generated from that date [10-15].

In Chile, there is a study that describes this type of injury in the North Metropolitan Health Service (SSMN) that included the period between 2000 and 2008 that included a total of 33 patients, but is focused on bone-type injuries [4]. In addition, these data are not available in other services, so it is not possible to compare with other populations When comparing our study with the one published by the SSMN, both present similar results in terms of: higher frequency in men (72.7 %), higher frequency in adolescents (51.5% between 10 to 14 years) and higher percentage occurred on public roads (48.8%). However, these present an increase in this type of injury over time.

The main strength of this study is that it is the first descriptive study of this type of injury in the pediatric population, which includes the calculation of the incidence of GW in pediatric patients in Chile. Among the limitations of this study, the following stand out: that it is a retrospective study therefore it is subject to data that were recorded and limited by those that did not have such a record, which can lead to information biases. Therefore, another limitation was the underreporting of some data, both from the injury and the patient, whether they are data considered in our analysis or other types of demographic data that could help to better characterize the affected population and thus determine, other associated risk factors (socioeconomic level, place of residence, use of illicit substances, previous history).

For future studies, it would be interesting to compare the results with the rest of the metropolitan and national health services. Even generating South American statistics, which could reflect that firearm injuries are a growing problem that should be a basic understanding of pediatric surgeons. In addition, a prospective study could be carried out by monitoring these patients to determine the sequelae and/or long-term consequences of this type of injury.

This is why, although they have a low frequency but high morbidity, in addition to the fact that most consultations for this type of injury will require evaluation and management by a pediatric surgery team, it means that emergency personnel have to be specially prepared for they. It is important to generate prospective records that allow us to monitor this type of injury, in order to have a better notion of the degree of affectation of the pediatric population of Chile, due to firearm injuries. Thus, to be able to implement different public policy measures that allows better prediction, prevention and management of these patients.

References

1. Petty JK, Henry MCW, Nance ML, Ford HR, APSA Board of Governors. Firearm Injuries and Children: Position Statement of the American Pediatric Surgical Association. Pediatrics. 2019;144(1):e20183058.
2. Cunningham RM, Walton MA, Carter PM. The Major Causes of Death in Children and Adolescents in the United States. N Engl J Med. 2016;379(25):2468-75.
3. Carter CW, Sharkey MS, Fishman F. Firearm-related musculoskeletal injuries in children and adolescents. J Am Acad Orthop Surg. 2017;25(3):169-78.
4. Muñoz O, Larraín C, Moya H. Heridas por arma de fuego en niños. Revista Pediatrìa Electrónica. XLIII Jornadas de Investigación Pediátrica, Santiago Norte. 2008;5(2).
5. Naghavi M, Marczak LB, Kutz M, Shackelford KA, Arora M, Miller-Petrie M, et al. Global Mortality From Firearms, 1990-2016. JAMA. 2018;320(8):792-814.
6. Leventhal JM, Gaither JR, Sege R. Hospitalizations due to firearm injuries in children and adolescents. Pediatrics. 2014;133(2):219-25.
7. Barahona OP, Quezada OP. Adolescentes heridos por arma de fuego y sus factores biosocioeconómicos relacionados. Acta Pediátrica Hondureña. 2017;8(2):776-84.
8. Shaahinfar A, Yen IH, Alter HJ, Gildengorin G, Pan SMJ, Betts JM, et al. Long-term Mortality in Pediatric Firearm Assault Survivors: A Multicenter, Retrospective, Comparative Cohort Study. Acad Emerg Med. 2018;25(12):1447-57.
9. Fraga AM, Bustorff-Silva JM, Fernandez TM, Fraga GP, Reis MC, Baracat EC, et al. Children and adolescents deaths from trauma-related causes in a Brazilian City. World J Emerg Surg. 2013;8(1):52.

10. Cotton BA, Nance ML. Penetrating Trauma in Children. Semin Pediatr Surg. 2004;13(2):87-97.

11. Bayouth L, Lukens-Bull K, Gurien L, Tepas JJ, Crandall M. Twenty years of pediatric gunshot wounds in our community: Have we made a difference? J Pediatr Surg. 2019;54(1):160-4.

12. Barry WE, Barin E, McLaughlin CM, Strumwasser A, Shekherdimian S, Arbogast H, et al. Pediatric firearm injuries in Los Angeles County: Younger children are more likely to be the victims of unintentional firearm injury. J Pediatr Surg. 2019;54(2):350-3.

13. Prickett K, Gutierrez C, Deb S. Family Firearm Ownership and Firearm-Related Mortality Among Young Children: 1976-2016. Pediatrics. 2019;143(2):e20181171.

14. Madhavan S, Taylor JS, Chandler JM, Staudenmayer KL, Chao SD. Firearm Legislation Stringency and Firearm-Related Fatalities among Children in the US. J Am Coll Surg. 2019;229(2):150-7.

15. Goyal MK, Badolato GM, Patel SJ, Iqbal SF, Parikh K, McCarter R. State Gun Laws and Pediatric Firearm-Related Mortality. Pediatrics. 2019;144(2):e20183283.