Original Article

Firearm Injuries in Children: Four-year Experience from a Rural Tertiary Care Centre of Northern India

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Abstract

Background: Firearm injuries (FAIs) continue to be a global public health problem possessing substantial emotional, physical and financial burdens on hospital resources. Although FAIs are rare in children, their incidence is gradually increasing. **Aim:** The aim of this study was to evaluate various aspects of FAI in children that were managed at a tertiary care centre located in the rural part of India. **Materials and Methods:** This clinical observational study of children <18 years of age, all due to FAI, was conducted at a tertiary care centre located in the rural part of India. Data of all children admitted with FAI over 4 years from January 2016 to December 2019 were collected. Recorded data included age, sex, motive (intentional/unintentional) and circumstances leading to injury, type and license status of firearm used, time of injury, pre-hospital care, mode of transport to hospital, duration between injury and arrival to hospital, body parts and organs injured, trauma scores, management, complications, length of hospital stay and outcomes. The recorded data were entered into a worksheet and analysed. **Results:** Out of 283 cases of FAI admitted, only 24 were children with age <18 years (8.48%). The mean age was 12.66 years (male:female = 2.4:1). Sixteen were intentional (66.67%) and eight were unintentional (33.33%). The family feud was the most common reason in case of intentional FAI (43.75%), and mishandling was the most common reason in case of unintentional FAI. Country made gun was the most common firearm used (62.5%). The chest and upper back were the most common sites of injury (54.16%). Intercostal drainage tube insertion was the most common surgical procedure performed (33.33%). There were three mortalities (12.5%). **Conclusion:** The present study found that intentional FAIs in children were more common than unintentional FAIs with family feuds and mishandling being the most common causes, respectively. The unlicensed country-made gun was the most common firearm causing injury in children.

Keywords: Chest injury, children, firearm, intercostal drainage tube, rural, violence

Introduction

Firearm injuries (FAIs) continue to be a global public health problem possessing substantial emotional, physical and financial burden on the hospital resources and community as a whole.[1] As a result of the easy availability of arms and ammunition, deterioration of moral values along with lack of proper law enforcement, the incidence of FAI is on the rise.[2] The increasing incidence of FAI can also be attributed to increasing communal and ethnic clashes, political violence, robberies and suicides.[3] In some parts of Africa, FAIs have become a leading cause of unnatural deaths.[4] In India, there has been a rapid proliferation of illegal firearm business, especially in Bihar, Jharkhand and Uttar Pradesh, leading to higher fatalities due to FAI in these parts of the country.[5] India officially reported a national firearm killing rate of 0.36/100,000 persons against an average national murder rate of 2.8/100,000 persons/year.[6] Although FAIs are rare in children, their incidence is gradually increasing in developed nation like America.[7] Various studies across India and world have shown a higher incidence of FAI in the third and fourth decades of life.[8-12] Firearms and their use are modifiable risk factors that if understood and addressed could help to reduce the burden of FAI in children. Unintentional FAIs are less frequent than intentional FAIs and also have a higher nonfatal to fatal FAI ratio.[13] Although many articles

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have been published on FAI from developed nations, hardly any article detailing the frequency, trend, and incidence of FAI in children has been published from India. This article focuses on various aspects of FAI in children that were encountered at a tertiary care centre located in the rural part of India.

Materials and Methods

Study settings

The study was conducted at a tertiary care centre located in the rural part of Uttar Pradesh, India, which caters primarily to the rural population. The institute has advanced critical care facilities including accident and emergency department. It has also state-of-the-art cardiac surgery, paediatric surgery, neurosurgery and Anaesthesiology departments that are part of the multidisciplinary team, who treats ballistic trauma patients.

Study design and data collection

This clinical observational study of children <18 years of age, all due to FAI, was conducted jointly by the department of paediatric surgery, cardiovascular thoracic surgery and paediatric medicine at the lead author's institution. Medical records of all children admitted with FAI between January 2016 and December 2019 (4 years) were studied, and the important data were collected after clearance from the institute's ethics committee (IEC no: 110/2020-2021). Recorded data included age, sex, motive (intentional/unintentional) and circumstances leading to injury, type and license status of firearm used, time of injury, pre-hospital care, mode of transport to hospital, duration between injury and arrival to hospital, body parts and organs injured, trauma scores, management, complications, length of hospital stay and outcomes. Further, injuries were classified as nonfatal if the children were discharged from the hospital alive and fatal in the event of death while undergoing treatment.

Statistical analysis

The observed data were entered into an Excel sheet (Microsoft Excel 2016 home and student version) and analysed using SPSS software (the Statistical Package for the Social Sciences, version 17.0, SPSS Inc., Chicago, Ill, USA). The said software was used to calculate measures of central tendency (mean, median and mode), range and percentages.

Results

A total of 283 cases of FAI were admitted to the hospital during the study. Out of these 283 cases, only 24 were children with age <18 years constituting only 8.48% of all FAI. The age of the children ranged from 9 to 17 years with a mean of 12.66 years. Out of 24 children, 17 (70.83%) were male and 7 (29.17%) were female with a male-to-female ratio of 2.4:1. Out of 24 FAI, 16 (66.67%) were intentional and 8 (33.33%) were unintentional. The most common reason in case of intentional injury was a family feud, 7 out of 16 (43.75%) [Table 1]. Other reasons in cases of intentional FAI were robberies, suicides and group quarrels. In one case, the child was shot by his own father before committing suicide himself due to family issues. The reason was not known in the case of 3 (18.75%) children. In case of unintentional FAI, mishandling of firearms was the most common reason and was seen in three out of eight children [Table 1]. Other reasons were ceremonial gunfire, caught in crossfire, firearm malfunction and playing with the firearm. In the case of unintentional FAI, assailants were known to family members in four out of eight children, unknown to family members in three out of eight children, and accidental self-injury was noted in one child. Place of occurrence of injury was outskirt in 10 out of 24 children (41.67%), home in 8 out of 24 children (33.33%) and near home in 6 out of 24 children (25%). In majority of the children, injury occurred during daytime (14 out of 24) while in remaining children (10 out of 24) injury occurred during night. In the present study, country-made guns, commonly called 'katta', were the most common firearms used to inflict injuries in 15 out of 24 children (62.5%). Other firearms used were shotguns in 8 children (33.33%) and rifle in 1 child. Out of 24 firearms used, 15 were unlicensed (62.5%). Only 10 out of 24 (41.66%) children received pre-hospital care. Police vehicle or relative's vehicle was the most common mode of transport of the children to hospital and was noted in 16 out of 24 (66.67%) children. Only 8 out of 24 children (33.33%) were brought to the hospital in ambulance. Majority of children were brought to the hospital within 6 h of injury, 16 out of 24 children (66.67%). The chest and the upper back were the most common sites of injury seen in 13 out of 24 children (54.16%) [Table 2]. The other sites of injuries were the abdomen and lower back in 6 out of 24 (25%) children, extremities in 4 out of 24 children (16.67%), and head and neck in 1 (4.17%) child. Nonfatal injuries were more common and seen in 21 (87.5%) children, whereas fatal injuries were seen in three children. Using the Kampala trauma score II (KTS), the majority of the injuries were severe (KTS <6) and seen in 14 out of 24 (58.33%) children. Moderate injuries (KTS = 7

Table 1: Reasons in cases of intentional and unintentional firearm injuries in children

	Number of cases (%)
Reasons in case of intentional FAI	
Family feud	7 (43.75)
Not known	3 (18.75)
Suicide	2 (12.5)
Robberies	2 (12.5)
Family issues	1 (6.25)
Group quarrel	1 (6.25))
Total	16
Reasons in case of unintentional FAI	
Mishandle	3 (37.5)
Ceremonial	2 (25)
Malfunction	1 (12.5)
Crossfire	1 (12.5)
Playing	1 (12.5)
Total	8

FAI: Firearm injuries

Table 2: Site of injury among victims

Site of injury	Number of cases (%)
Chest and upper back	13 (54.16)
Lung	8
Isolated chest wall	5
Abdomen and lower back	6 (25)
Bowel	3
Isolated abdominal wall	2
Bowel + liver	1
Extremities	4 (16.67)
Lower limb	2
Upper limb	2
Head and neck	1 (4.17)
Total	24

Table 3: Management of firearm injuries

Management of FAI	Number of cases (%)
Intercostal drainage	8 (33.33)
Primary closure	7 (29.16)
Laparotomy	4 (16.67)
Conservative	4 (16.67)
Thoracotomy	1 (4.17)
Total	24

FAI: Firearm injuries

or 8) were seen in 9 out of 24 (37.5%) children, whereas mild injury (KTS = 9) was seen in only one child. The lung was the most common organ injured in the present study (33.33%).

Intercostal drainage tube insertion was the most common surgical procedure performed in 8 out of 24 (33.33%) children. Primary closure of wound after cleaning and irrigation was performed in 7 (29.16%) children [Table 3]. Exploratory laparotomy was performed in four children. Four children were managed conservatively with wound dressings, and thoracotomy was performed in one child.

Length of hospital stay in case of nonfatal injuries ranged from 6 to 13 days with a mean of 8 days. There were 3 (12.5%) mortalities in the present study. Out of three mortalities in the study, two mortalities were seen in the emergency room itself within 25 min of arrival at the hospital. Both children were in severe refractory shock. One of the children had an injury to the face and trachea and the other had lung injury. Mortality in one child was seen after 11 days of admission. Three children developed surgical site infection in the postoperative period, and persistent air leak was noted in two children having lung injury.

Discussion

In the present study, out of 283 cases of FAI admitted during the study period only 24 (8.48%) were children which are in accordance with the other studies reported from India where maximum incidence has been reported in the third decade of life and minimum incidence in children and 60 years of age and beyond.[8-11,14] The mean age in the present study was 12.66 years which is similar to a study done on FAI in children by Allareddy *et al*. in the USA.[15] In the present study, males were more commonly affected than females in agreement with other studies.[8-11,14,15] This is because in cases of family feud, property disputes or revenge the assailants tend to eliminate the entire family of the victim, especially boys supposed to be prospective heirs. Traditional Indian upbringing which provides gender-specific toys to young children is also to be blamed for predisposing boys to FAI as they develop curiosity to explore toy guns and similar-looking real firearms. The incidence of intentional FAI in the present study was 66.67% signifying that it was more common than unintentional FAI, a finding similar to other studies.[13,15] However, this incidence was lower than reported in various other studies,[8,11,16,17] where it ranged from 73% to 99.1%. A possible explanation for this can be that all these studies were done in the population as a whole and not specifically in children. The study by Khan *et al*.[18] found that unintentional FAIs were more common in children and were mostly nonfatal. This is similar to the observation made in the present study where all the unintentional FAIs were nonfatal and all fatal injuries were intentional. This is also in agreement with the study of Annest *et al*.[13] who observed that unintentional FAIs have a higher nonfatal-to-fatal ratio. A possible explanation for higher unintentional FAI in children as compared to adults can be that they are difficult to control in gathering, get attracted towards unsafely stored firearms at home and their inquisitive and exploring nature can get them accidentally injured while playing with loaded firearms.

In case of unintentional FAI, mishandling of the firearms was the most common cause which is in agreement with the study of Singh and Singh[17] who reported the mishandling of firearms or hunting as the most common cause of FAI in northern India. This is also in agreement with Karger *et al*.[19] who reported that humans themselves are responsible for their actions rather than technical faults. Ceremonial gunfire was also a cause of unintentional FAI in the present study as it is a common method for celebration in this part of the country, especially in marriages. The assailant was known to the victim in cases of intentional FAI in 70% of cases which again can be explained by the most common motive of family feud. This is higher than the percentage reported by Khan *et al*.[9] whose study group mainly comprised adults.

In the present study, country-made firearms (katta) were the most common weapon causing injuries, which is in agreement with the other study done in northern India by Kumar *et al*.[14] Approximately 62% of weapons that were responsible for inflicting injuries in the present study were unlicensed. This can be related to the fact that, in India, there has been a rapid proliferation of illegal firearm business, especially in Bihar, Jharkhand and Uttar Pradesh, leading to higher fatalities due to FAI in these parts of the country.[5] There is also rise in the use of illegal and unlicensed country made guns (katta), especially in rural areas. These illegal and unlicensed firearms are being conveniently used in robberies,

thefts, murders and suicides as they are available cheaply and in abundance.

Another striking observation in the study was that most of the children were brought to the hospital by family members, relatives or neighbours who had no idea of providing pre-hospital care in such types of injuries, and thus 14 out of 24 (58.33%) children did not receive any pre-hospital care which is in agreement with the study done in this part of India by Singh *et al*.[11] Mode of transport to hospital in cases of such injuries is a major problem in rural areas as well-equipped ambulances are limited in this area and hence most of the children in the present study were brought by police vehicles or relative's vehicle. As most of the victims belonged to the adjoining rural areas, the majority of them were brought to hospital within 6 h of injury which is in agreement with the other study from this region.[11]

The chest and upper back were the most common sites of injury in the present study. It may be because this region is easier to aim from a long distance. There were two cases of attempted suicide, and in both cases, chest and upper back were the site of injury which is different from the site (head and neck) reported in other studies.[9,14,20] This can be explained by the difference in the age group of the cohorts. The present study included only children who may have found easier to use the firearm with both hands and hence choosing the chest as the site for firing. The lung was the most common organ to be injured because the chest and the upper back were the most common site of injury. In the present study, KTS II was used to determine the severity of the injury. KTS has been used as a triage tool for use in low- and middle-income countries as it is an effective predictor of mortality in low-resource settings.[21,22] According to KTS II, majority of injuries in the present study were severe (55.55%) as the injuries were penetrating and damaged vital organs such as the lungs, liver and bowel. Intercostal drainage tube insertion was the most common surgical procedure (33.33%) performed as majority of the injuries involved the chest and lungs.

Length of hospital stay for nonfatal injuries was longest of 13 days seen in two children. One of these child had chest injury for which the child underwent thoracotomy and another child had abdominal injury for which child underwent laparotomy. There were three mortalities out of which two children succumbed to their injuries within 25 min of their arrival in the hospital. Mortality in one child was seen after 11 days of admission. This child had liver injury along with bowel injury and underwent laparotomy and packing of the liver along with colostomy. However, she succumbed to injury due to sepsis.

Understanding the factors associated with FAI in children can help in preventing such injuries. Relatively easier availability of firearms at home, especially unlicensed and country-made guns lacking safety mechanisms, unsafe storage practices, traditional culture of ceremonial firing, traditional Indian upbringing of children which provides gender-specific toys such as guns for boys, playing shooting games on gaming consoles, in which children try to copy the characters of game in real life are all contributory factors for FAI in children. It is essential that each of these factors is dealt with and stringent laws are made and enforced for sale, storage and use of unlicensed country-made guns.

Conclusion

Although FAIs are rare in children, their incidence is gradually increasing in developing countries. The present study found that intentional FAIs in children were more common than unintentional FAIs with family feuds and mishandling being the most common causes of them, respectively. Unlicensed country-made gun was the most common firearm causing injury in children. Relatively easier availability of firearms, use of cheaply available unlicensed country-made guns lacking safety mechanisms and unsafe firearm storage practices are the major factors responsible for these injuries.

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Conflicts of interest

There are no conflicts of interest.

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