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GUNSHOT INJURIES AS SEEN AT THE AGA-KHAN HOSPITAL NAIROBI, KENYA
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GUNSHOT INJURIES AS SEEN AT THE AGA KHAN HOSPITAL, NAIROBI, KENYA

H. S. SAIDI, J. NYAKIAMO and S. FAYA

ABSTRACT

Objective: **To determine the prevalence, injury patterns, offender-victim characteristics, treatment and outcome of firearm-related injuries at the Aga Khan Hospital, Nairobi.**
Design: **Retrospective descriptive study.**
Setting: **The Aga Khan Hospital, a major private hospital in Nairobi.**
Subjects: **One hundred and seven patients who presented at the Aga Khan Hospital Accident and Emergency Department (January 1993- December 1998) with firearm injuries and were subsequently hospitalised. There were 97 males and 10 females aged four to 94 years. The mean age was 39 years.**
Results: **The peak incidence was in the 40-49 year age group. The male to female ratio was 10:1. The victim offender was a thug, thief or robber in 74.7% of cases. Law enforcement officers were responsible for 9.4% of the injuries. The Injury Severity Scores (ISS) ranged from one to 32 with mean score of 8.25. Injuries involving the extremities were the most prevalent. There were 31 major operations performed. The complication rate was 35.5%. Six (6.5%) of these patients died.**
Conclusion: **Gunshot injuries cause profound morbidity and significant mortality. A wider and larger study needs to be undertaken to elucidate the true nature of firearm injuries.**

INTRODUCTION

Trauma leads other causes of death and disability in people aged below 35 years(1). By the year 2020, trauma will be a leading cause of life-years lost in both developing and developed countries(2). In Kenya, trauma of all causes is the fourth leading cause of death(3). With increasing sophistication and social violence, the incidence of injury is likely to escalate. Like other developing countries, Kenya can ill-afford this. The response of these countries' health care systems to increasing trauma is hampered by poor economic conditions. Prevention strategies are the key. But to effectively design these strategies, trauma databases are crucial.

The incidence of gun shot injuries is increasing throughout the world. In the USA, gun violence accounts for over 99,000 non-fatal injuries, 3.6 times the number of fatalities(4). Gun violence in USA is estimated to become the leading cause of nationwide trauma deaths by the year 2003(5). One in 20 civilians is at risk of being fatally shot or stabbed in South Africa. A recent study in this African country notes a significant shift from stab to bullet spinal injuries(6). A Nigerian study by Adesanya *et al* notes an increasing prevalence of abdominal gunshot wounds(7). Few studies on gunshot wounds in Kenya are available(8,9). The frequent print and electronic media reports of gun violence indicate an increasing crime level in the country. The high and rising unemployment and poverty rates in the country(10) can only mean Accident and Emergency (A&E) departments in our hospitals will have to handle increasing volumes of trauma including gun violence. This study analyses gunshot wounds (GSW) at the Aga Khan Hospital, Nairobi, during a five-year period with the objective of evaluating the pattern and outcome of these injuries. It is hoped that it will provide further insight into the epidemiology of injury in Kenya.

MATERIALS AND METHODS

This study was carried out at the Aga Khan Hospital, one of the four major private hospitals in the city of Nairobi. The hospital serves the health needs of the urban and peri-urban middle and high-income residents of the City. One hundred and seven consecutive patients with gunshot injuries were treated at the hospital between January 1993 and December 1998. Analysis involved retrospective review of patients information. Data concerning age, sex, injury circumstance, injury distribution, treatment, and outcome were extracted from the medical records. There were 97 males and 10 females. Excluded from the study were cases not admitted into the hospital and the patients who died before hospitalisation.

The injuries were grouped according to standard anatomical regions (head and neck, chest, abdomen/pelvis, extremities and the spine). Upper body injury comprised injury to the head, neck, chest and upper limbs. The injury severity was graded using the Injury Severity Score (ISS) according to Baker *et al*(11). In this scoring system, injuries in each of six body regions are scored according to the Abbreviated Injury Scale (AIS) dictionary. The scores range from 1 (mild) to 6 (incompatible with life). The ISS is the sum of squares of the three highest area scores. AIS-90 (1990 edition) was used to manually calculate the ISS. ISS greater than 9 denotes significant single region injury while ISS of 15 is the threshold level for significant polytrauma.

Treatment groups comprised surgical toilet and wound care alone, surgical toilet in combination with minor surgery and surgical toilet in combination with major operation. Laparotomies, craniotomies, thoracotomies, open reductions and internal fracture fixations and complex soft tissue reconstructions constituted the major operations. Minor procedures included bullet exploration and retrieval, external fracture stabilisation, chest drainage and wound cover. The outcome was denoted excellent if the injuries healed uneventfully, satisfactory if complications ensued but resolved in the course of treatment and poor if patient died or sustained permanent disability. The information was entered on a pre-coded data sheet and fed into the computer then analysed for means, proportions, and statistical differences using SPSS-PC statistical software.

RESULTS

Age/sex: A total of 107 patients were analysed in this study. The yearly admission prevalence is shown in Table 1. The highest admission rate was in 1995 (twenty five) and the lowest in 1997 (nine). The mean annual rate of admissions was 18. The ages ranged from four to 94 years with a mean of 39.12 years. The peak victim age group was 40-49 years (Table 1). More than forty eight per cent of the patients were younger than 40 years. Four (7.2%), forty seven (48.5%) and five (5.2%) patients were younger than 20, younger than 40 and older than 60 years respectively. The male to female ratio of about 10:1 (Table 1).

Table 1

Patient characteristics

Characteristic	No.	%	Cumulative %
i) Yearly trends in number of patients seen			
Year			
1993	13	12.1	12.3
1994	21	19.6	31.7
1995	25	23.4	55.1
1996	20	18.7	73.8
1997	9	8.4	82.2
1998	19	17.8	100
ii) Age characteristics (Mean age 39.1: Age range years 4 - 94)			
Age			
0-9	3	3.1	3.1
10-19	1	1.0	4.1
20-29	22	22.7	26.8
30-39	21	21.6	48.5
40-49	32	33.0	81.4
50-59	13	13.4	94.8
≥60	5	5.2	100
iii) Gender characteristic			
Sex			
Male	97	90.7	90.7
Female	10	9.3	100

Circumstances and body region prevalence: The victims sustained injuries in circumstances related to violent robbery in 74.7% of the cases. The offender was a law enforcement officer (police) in 9.4% (n = 10) of the shootings while in 3.8% of the victim population, the injury was caused by stray bullets or shoot-outs related to civil war (Table 2). No details were available for 13 (12.1%) patients.

The commonest injuries encountered involved the upper and lower limbs. These were involved in 51% (n=60) of 118 regions in 107 patients. The upper limb was involved in 26.3% and the lower limb in 24.6% of these injuries. The head and neck (20.3%) and the chest (16%) were next in the order of frequency of involvement (Table 2). The abdomen and spine were involved in 10.2% and 2.5% of the injuries. Two thirds of the injuries involved the upper half of the body (67.7%). This area was targeted by thugs and law enforcement officers (police) in 70% and 50% of the cases respectively.

Table 2

Injury characteristics

Characteristic	Frequency (no.)	%
(i) Offender		
Thugs/robbers	80	74.7
Police	10	9. 35
Stray bullet	2	1.9
Warzone	2	1.9
Missing data	13	12.14
(ii) Anatomical zone affected		
Head and neck	24	20.3
Chest	19	16.1
Abdomen and pelvis	12	10.2
Upper limbs	31	26.3
Lower limbs	29	24.6
Spine	3	2.5
Total	118	100

Specific injuries and injury severity: Long bone fractures were the commonest skeletal injuries. Out of the 29 injuries recorded in the lower limbs, ten fractures involved long bones and three, other bones. There was one vascular injury and 15 soft tissue injuries (STI). In the upper limbs, long bone fractures comprised eleven out of 30 injuries. There were eight other fractures, eight soft tissue lesions and four neuro-vascular lesions. Injuries in the head and neck region comprised three cranio-cerebral penetrations, seven mandibular fractures, three fractures of the maxilla and zygoma, three orbital injuries and eight soft tissue lesions. In the chest, there were nine cases of haemothoraces/haemopeumothoraces, out of 16 injuries. There was one rib fracture and nine injuries involving the thoracic wall without penetration. Analysing spine injuries, all the injuries involved the thoracic spine and in all the three instances (twelfth, fifth-sixth, third-fourth) the cord was involved. In the abdomen, there were five bowel perforations and four liver/gallbladder injuries. In three patients the peritoneum was not penetrated. The Injury Severity Score (ISS) ranged from one to 32 and averaged 8.27. Most injuries scored 9-15 (Table 4). The proportion of patients with ISS > 9 was 53%. Those with injuries above ISS of 15 comprised 17.4% of the population. ISS mean (9.57 ± 8.3)) during the initial half of the study period was significantly (p = 0.006) lower than the later half-period (4.67 ± 5.37).

Table 3

List of injuries by anatomical regions

Region	Injuries	No. (%)
Head and neck	Cranio-cerebral injury	3 (12.5)
	Mandible fracture	7 (29.2)
	Zygoma/maxilla fractures	3 (12.5)
	Orbital trauma	3 (12.5)
	Soft tissue lesions	8 (33.3)
Thorax	Haemothorax / haemopneumothorax	9 (47.4)
	Fracture ribs	1 (5.2)
	Soft tissue lesions	9 (47.4)
Abdomen	Colon perforation	3 (25.0)
	Small gut perforation	2 (16.6)
	Liver/gall bladder injury	4 (33.3)
	Superficial abdominal wall	3 (25.0)
Upper limbs	Long bone fracture	11 (36.6)
	Other fractures	8 (26.6)
	Soft tissue injuries	8 (26.6)
	Neurovascular injuries	4 (13.3)
Lower limbs	Long bone fractures	10 (34.5)
	Other fractures	3 (10.3)
	Soft tissue lesions	15 (51.7)
	Vascular injury	1 (3.4)
Spine	Thoracic spine with cord trauma	3 (100)

Treatment: All the wounds were subjected to initial surgical toilet and the open wound then dressed and patient covered with antibiotics. Wound excision and debridement was performed for dead and damaged tissues that were grossly contaminated. This treatment alone sufficed for 29 (30.2%) of the patients. In 31 (32.3%), surgical toilet in combination with a major surgical procedure was undertaken. There were eleven laparatomies, eight open reductions and fixation of bone fractures, two thoracotomies, two craniotomies and eight other operations. The highest operation rate was for abdominal gunshot wounds (11/12). In 36 (37.5%) of the victims, surgical toilet in combination with a minor surgical procedure was performed. There were sixteen bullet explorations, five insertions of intercostal tubes, nine external fracture fixations, one mandibular wiring and five wound closures.

Table 4

Injury severity scores, treatment and outcome of GSW

Characteristic	Frequency (No.)	%
Injury scores		
1	24	22.4
2-8	21	19.6
9-15	29	27.1
15-24	15	14.0
≥ 25	7	6.5
Missing	11	10.3
Total	107	100
Treatment offered		
Conservative	29	30.2
Minor surgery	36	37.5
Major surgery	31	32.3
Total	96	100
Outcome		
Good	54	505 7
Complications occurred	24	22.4
Poor (death/disability)	14	13.1
Missing	15	14.0
Total	107	100.0

Outcome: The outcome was excellent in 50.5% and satisfactory in 22.4% of the cases (Table 4). The overall complication rate was 35.5%. The outcome was poor in fourteen (13.1%) cases. Six patients (5.6%) died while undergoing treatment for abdominal (three), head (two) and chest trauma (one) and eight had disability requiring long-term rehabilitation. These disabilities included paraplegia, tetraplegia, and peripheral nerve injuries. The commonest overall complication was sepsis. This was recorded in fifteen patients (14%).

DISCUSSION

The results of this study show a mean annual admission prevalence rate of 18 GSW at this medium sized private hospital in Nairobi. A similar study at the 1500-bed referral and teaching hospital in the city reveal a rate of 39 GSW(9). Both the figures do not reflect the occurrence of this high velocity trauma as the studies only considered survivors. A study analysing survivors, accident and emergency deaths and deaths outside hospitals will provide a more complete picture. Estimates elsewhere put the ratio of non-fatal to fatal firearm injuries at about 3:1(4). An average of twenty cases of GSW per year means that the average senior house officer at the Accident and Emergency department would seldom encounter this major and often complex trauma. Up to 53% of the patients (ISS >9) will demand timely, methodical and appropriate early care to guarantee a satisfactory outcome. In 17% of such patients (ISS > 15), the need to avoid diagnostic errors at the A&E and institute appropriate emergency room therapy and resuscitation will be even more crucial to avoid preventable mortality(12).

The worldwide incidence of GSW worldwide is dependent on the availability of handguns, prevalence of gang violence, civil unrests and the prevailing rate of poverty and crime. We report a mean age of 39 years and a peak in the 40 - 49 year age group. This population is older when compared to victims of GSW in other studies(4,7,9,13,14). In Los Angeles, between 1974 and 1985, over half of 10,000 victims of GSW were 15-20 years old with a mean age of 19 years(13). In the USA the most remarkable increase in the number of homicides due to firearms is among persons 15-24 years of age(14). At the Kenyatta National Hospital in Nairobi, 50.7% of the victims were aged 21-30 years(9). These differences reflect the different circumstances of the injuries in the populations cited.

The aetiology of GSW in the under 20 of Los Angeles was predominantly due to gang-related activities(15). In both our study and that at the Kenyatta National hospital, most injuries were sustained in circumstances related to robbery. The victims in our study would be the well-to-do, in their middle ages, with appreciable material acquisitions over time to attract robbers. Those at the national hospital

would be poor and unemployed youth who by the nature of their circumstances, live in neighborhoods that harbour criminals and often be the crime perpetrators themselves. The victim-offender relationship in this study involved law enforcement officers in 9.3% of the cases. It corroborates the finding of the local study (9) and contrasts the situation in the West. In the USA, only 1.8% of firearm- related injuries occur during legal intervention by these officers(4).

The predominance of males over females seen in this study is a general trauma trend(3,4,9,16). Males are more likely to involve in gang violence, violent robberies, banditry, war and misuse of drugs which expose them to firearm injuries.

The effects of gunshot wounds depend on the site affected, type of bullet and the adequacy of surgical care. By definition, any bullet travelling below the velocity of sound (1,100 ft/sec) is a low velocity missile(17). It was not possible to capture information on weapons used from the records in this study. But, presuming that thieves and robbers would attack homes and cars, it is conceivable that the likely weapons were low velocity handguns. The severity of the wound depends on the size, shape, stability, composition of the bullet and the density and elasticity of the tissues. The tissue factors influence the retardation of the penetrating bullet. A wound results from the absorption of energy impacted by a missile when it strikes and penetrates tissue. The available kinetic energy is a function of the bullet mass and velocity via a relationship where doubling the mass doubles the energy available while doubling the velocity quadruples the energy. The results of this study show diminishing lethality of the weapons used in GSW. We could find no explanation for the finding and advise caution in its interpretation and recommend a more comprehensive analysis of GSW outcome.

Missiles injure tissues via three main mechanisms. Laceration and crushing is the principal effect of low velocity missiles where there is no hidden damage apart from the ones seen at operation. In injury by shock waves, the missile compresses the tissue in fronts of it in such a way that the tissue moves away as a spherical shock wave. The velocity of the shock wave is similar to that of sound in water (4,800 ft/sec) and it causes damage at considerable distance from the wound track. The third mechanism is via the phenomenon of temporary cavitation. This is the principal mechanism in high velocity wounds. The energy released accelerates tissues forward and outward. By their inertia, the tissues take time to get moving and then their momentum causes them to continue moving after the passage of the missile. This creates a large cavity, 30 to 40 times the diameter of the missile. This cavity is at sub-atmospheric pressure and sucks in bacteria and debris into the depths of the wound.

The predominant extremity injury demonstrated corroborates other published studies(4,9,18). In the USA, out of 4,468 non-fatal injuries over one year, 35.4% involved the leg or foot(4). The most severe extremity injury is a moderate injury on the Abbreviated Injury Scale with attendant low mortality(11). The preponderance of skeletal injuries therefore skewed the overall ISS towards mild to moderate injuries. Injuries to the head and neck, thorax and abdomen are associated with higher mortalities. These are likely to be the predominant injuries in gunshot injuries leading to immediate deaths.

The current study reveals a complication rate of 35.5%. The 5.6% mortality rate is comparable to that of Annest *et al*(4). In their study, 91.6% of patients who required hospitalisation were discharged from hospital alive. The external validity of the figures in our study is limited by the case mix of mild and severe injuries. In trauma center studies the overall mortality may approach 20-25% due to exclusion of minor injuries(17). Results of a study at Kenyatta National Hospital in Nairobi indicate a surprisingly low mortality rate of 2.2%. It may be that in this centre, due to prolonged pre-hospital times, severe injuries did not reach the hospital(9).

The high overall complication rate, the mortality (5.6%) and disability (8.9%) rates attests to the enormous societal costs that a single bullet may cause. Gun control, enhanced general security in the city and the alleviation of poverty and unemployment may reduce these costs.

CONCLUSION

The study has highlighted the demographic profile and injury patterns of GSW at the Aga Khan Hospital, Nairobi. Most of the GSW were due to circumstances related to robbery. It suggests a decreasing trend over the six years in the injury severity. GSW are associated with profound morbidity and mortality. More work is needed to highlight the injury characteristics of those who die before hospital arrival, nature of the weapons used, seasonality of GSW, wound ballistics and the factors determining treatment modalities and outcome. The power of a similar study will be boosted with a larger citywide study. The study should shed more light on the disturbing observation that law enforcement officers apparently shoot to kill 50% of the time.

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Scientific Letter to the Editor-in-Chief

Dear Sir

RE: RHEUMATOLOGY IN KENYA: 2000 AND ONWARDS

In February 2000 at the invitation of the Kenya Association of Physicians, Paul McGill, consultant rheumatologist and Elizabeth McIvor, Rheumatology nurse specialist from Glasgow in Scotland and Girish Mody, professor of Rheumatology from Durban, Natal and Gill Brown Rheumatology nurse specialist from Cape Town South Africa travelled to Nairobi to conduct/participate in a series of postgraduate medical and nursing lectures and seminars culminating in a one day rheumatology symposium.

At present no formal rheumatology service exists in Kenya and our presence reflected a perceived need for and a desire among some physicians to see this established. Rheumatology in Kenya is at present practised by general physicians who in the main have had no structured training in the specialty leading to specialist accreditation. A trained and experienced individual is now required at the helm to develop a service to match the high standard of the other medical specialties in Kenya currently among the best in sub-Saharan Africa.

You might think it self evident that rheumatology should he represented alongside other medical specialties and be appropriately resourced even in hard pressed African countries. The fact of the matter is that at present there are but a handful of rheumatologists in the whole of sub-Saharan Africa outwith South Africa. To make a case in this situation is difficult given the relative paucity of accurate up-to-date information on disease prevalence. Nevertheless the evidence "on the street" points to the need for a basic rheumatology service and teaching capacity. Even when a case is made based on good evidence of need, the competition for very scarce resources may lead to divided loyalty among medics never mind politicians. A major objective of this exercise was to gain the support of the Kenya Association of Physicians by stimulating interest in the specialty and highlighting the benefits of a specialist rheumatology workforce in the detection and management of locomotor disorders. The programme was designed to cover a core curriculum in rheumatology but also, and very importantly, introduced the concept of nurse participation which is especially valid in the context of resource limitation. Therefore, each weekday morning the faculty met in the department of medicine at the Kenyatta National Hospital from 8-10 am for a series of tutorials and lectures followed by case presentations and consultative sessions for the remainder of the morning. These sessions were attended by postgraduates and consultantts. Lunch time and afternoon sessions took place in various Nairobi hospitals and were directed at the large number of private sector practitioners. Both medical participants have a long association with African medicine and rheumatology. For Paul McGill this was a nostalgic return to Nairobi after 30 years. From 1968-1980, he was a Lecturer in Medicine at the University of Nairobi together with others from Glasgow who helped establish the Nairobi Medical School, in particular Professor WFM Fulton ex Stobhill Hospital Glasgow. However, the invitation to participate came not from these past associations but from his continued interest in medical and rheumatology training in Africa. He is currently visiting professor of medicine at the University of Zambia Medical School. Girish Mody currently holds the Chair of rheumatology at the University of Durban Natal and he is President of the African League Against Rheumatism (AFLAR). Gill Brown is a rheumatology nurse specialist and educator at the University of Cape Town, South Africa. In this capacity she is ideally placed and determined to promulgate rheumatology nursing in South Africa and nurses at the KNH were exposed to the wealth of her experience in a three-day post conference teaching. Elizabeth McIvor the novice in the team and NBTA (never been to Africa) rose to the occasion with a series of lectures at several venues and presentations at the symposium. Nairobi was a debut for ihit and runî team approach. It is too early to judge if these efforts will bear fruit. However, the strength of welcome and the enthusiasm with which the said efforts were received was humbling and certainly an optimise sign for the future.

Yours sincerely

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