

Sharp force fatalities at the Pretoria Medico-Legal Laboratory, 2012–2013

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Background: South Africa's crude death rate was recorded as the highest in the world in 2014. In 2013, 47 murders occurred daily nationwide, and it was confirmed that sharp force fatalities were frequent events. The aim of our study was to review the fatalities of persons admitted to the Pretoria Medico-Legal Laboratory over a two-year period. Understanding the magnitude of the problem, identifying the most commonly injured area and the mechanism of death in cases where the patient died in hospital could aid in the clinical management of some of these cases in order to reduce mortality.

Method: A retrospective descriptive case audit was conducted at the Pretoria Medico-Legal Laboratory from January 2012 through to December 2013.

Results: A total of 173 applicable cases were included. These comprised 5% of the annual case load. Most of the injured persons were male (84%) and aged 21–30 years (50%). Only 27 (16%) decedents were hospitalised and 12 (44%) survived for ≥ 1 day. The most predominantly injured area on the body was the thoracic area (65% of cases). Positive alcohol concentration in the blood was reported in 109 (66%) cases (a range of 0.01 g/100ml to 0.35 g/100ml). Exsanguination was the leading mechanism of death (85% of cases).

Conclusion: Compared with various international regions, an exceptionally higher percentage of these fatalities occur in Pretoria, South Africa. Most stab wounds penetrated the body's thoracic region, consequently perforating the heart and lungs, resulting in immediate death. The proportion of hospital fatalities of patients who sustained abdominal and extremity injuries, and who had already survived ≥ 1 day, was a worrying finding into which further research is required. It is surprising that these patients mostly succumbed to blood loss.

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Of the various traits distinctive to South Africa, its daunting fatality rate attracts considerable attention. It was reported in the Central Intelligence Agency's The World Factbook, that in 2014, the highest crude death rate worldwide occurred in South Africa.¹ According to Statistics South Africa, 458 933 fatalities were registered at the Department of Home Affairs in 2013, and by the following year, this figure had increased by 4%, with 47 murders taking place daily nationwide.^{2,3} The incidence of sharp force fatalities in South Africa was confirmed to be relatively frequent. In the province of Gauteng, in which this study was conducted, statistical assessments revealed that 3 333 murders were recorded in 2013, 14% ($n=452$) of which were sharp force-related deaths.⁴ Sharp force fatalities are observed in all manners of death, particularly homicides and suicides. Sharp force suicides, although encountered, are in the minority, and account for only 2–3% of all reported suicides.⁵ The majority of all sharp force-related deaths appear to be homicidal. Homicidal sharp force injuries (SFIs) occur predominantly in the thoracic region, commonly perforating the heart and lungs, whereas

suicidal SFIs are typically observed in the vasculature of the extremities.⁶

Sharp force fatalities, prevalent in South Africa, represent a common method of violence experienced globally. Seventy mortalities were attributed to SFIs in a retrospective study conducted in Lahore, Pakistan, over a two-year period, and accounted for 4% of all the post mortems conducted during that time.⁷ A total of 209 deaths, caused by sharp force violence, were identified over a five-year period in a review article based in Montreal, Canada.⁸ In Istanbul, 3 183 autopsies were conducted over a one-year period. Six per cent ($n=195$) of these were sharp force-related deaths.⁹

The aim of our study was to review the sharp force fatalities of patients admitted to the Pretoria Medico-Legal Laboratory over a two-year period. An understanding of the magnitude of the problem, identification of the area most commonly injured, and the mechanism of death in cases where the patient died in hospital could aid in the clinical management of some cases in order to reduce mortality.

Method

A retrospective descriptive case audit was conducted at the Pretoria Medico-Legal Laboratory. Admitted cases, where the cause of death was ascertained to be due to sharp force, from January 2012 through to December 2013, were included in this study. The exclusion criterion included cases in which SFIs were present, but which were not primarily responsible for the fatality. The cases were classified into various subgroups based on common characteristics. Collected data included the demographic details (age and gender), time and place of injury, anatomical location and characteristics of the wound (including organ and/or vasculature injured), medical care received, cause of death, manner of death, mechanism of death and alcohol concentration in the blood. In addition, the total number of cases conducted (case load) and number of deaths due to other trauma types (gunshot wounds, road traffic fatalities and assault) were documented. Ethical approval was obtained from the University of Pretoria, Faculty of Health Science Research Ethics Committee, prior to commencement of this study. Descriptive statistical analysis was conducted with the aid of a statistician.

Results

Three thousand, seven hundred and thirty-six cases were admitted to the Pretoria Medico-Legal Laboratory for the two-year period (2012–2013). Of these, 173 were sharp force related, and accounted for 5% of the case load. Gunshot wounds accounted for 399 (11%) of all admissions, road traffic fatalities (including railway fatalities) 1 123 (31%), and assault cases 188 (5%). (The latter were due to inflicted blunt force). Profiling of the cases admitted to the Pretoria Medico-Legal Laboratory was not included in the study aims. The remaining (approximately 50%) admissions included cases of asphyxial deaths, such as hanging, strangulation and drowning; sudden and unexpected deaths; procedure-related or -associated deaths and poisoning or drug-related deaths.

Demographic details

One hundred and forty (84%) of the injured persons were male and 27 (16%) female. The ages were divided into nine age groups of 10 years each. The youngest was two months old, and the oldest 88 years. There was a peak incidence in the age category of 21–30 years, which accounted for 87 (50%) of the cases. The injured persons were aged ≤ 21 years in 17 cases (10%).

Time of death

The hours in a day were divided into four different categories. The time of death was undetermined in 24 cases. The majority of deaths occurred between 21h01 and 05h00. Seventy-two cases (42%) occurred in this time range (Figure 1).

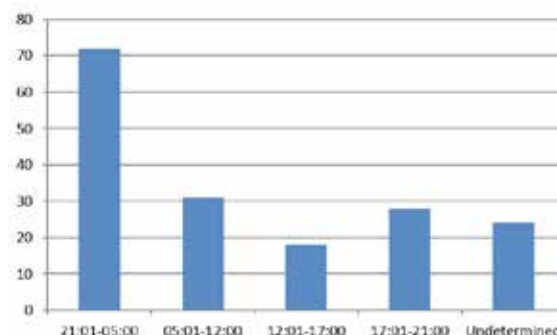


Figure 1: Time of death

Place of injury

Twelve points of interest were documented throughout the case files. Of these, the most common included private houses, informal settlements, open lands, roads and bars or taverns. Collectively, 62% of all injuries occurred in these places. The location where the injury took place was unknown in 47 cases.

Medical care

Seventy-one individuals (41%) died before any medical attention was provided. Forty-nine (28%) received emergency care, but died at the scene, and 27 (16%) were dead on arrival at the various hospitals. Only 26 (15%) decedents survived long enough to be hospitalised. Of those who received hospital care, nine (5% of the total cases, or 35% of the 26 cases admitted to hospital) survived for ≥ 1 day. Two weeks was the longest survival duration in hospital before the patient demised. Surgical procedures were conducted for 13 of the patients (48%) admitted to hospital. A summary of the patients admitted to hospital and who survived for ≥ 1 day is depicted in Table 1. Only six of the persons with stab wound injuries to the chest area (none involving the heart) received medical or hospital care. Their length of stay in hospital ranged from one hour to 1.5 days in hospital. The patient who demised after 1.5 days in hospital died from an ischaemic upper limb after the axillary artery was ligated during surgery.

Type of wound

The observed injuries in the 173 individuals were documented as either a stab wound (wound tract deeper than skin injury) or an incised wound (skin injury longer than depth of wound). Stab wounds were present in 107 cases (62%), incised wounds were found in 22 cases (13%), and both types of wounds were reported in 44 persons (25%).

Anatomical location of wounds

The body was divided into distinctive anatomical regions. The distribution of SFIs according to anatomical location is displayed in Figure 2. It is imperative to note that there were many instances in which one person sustained more than one SFI, either in different body areas, or multiple times in the same area.

Table 1: Summary of the injuries in decedents who survived for ≥ 1 day in hospital

Case number	Injured anatomical region	Complications
1	Left brachial artery	Wound sepsis and features of blood loss
2	Left axillary artery	Ischaemic left upper limb
3	Fifth intercostal space on the left	Bilateral pneumothorax and haemothorax still present at autopsy (intercostal drain only inserted on one side)
4	Eighth intercostal space on the left (injured diaphragm), and injured spinal cord	Spinal cord injury. No other complications listed
5	Stab wound to the head	Raised intracranial pressure
6	Stab wound to the head	Raised intracranial pressure
7	Stab wound to the neck, with injury to the right carotid artery	Features of extensive blood loss
8	Stab wound to the neck, with injury to the left external carotid artery and jugular vein	Features of extensive blood loss
9	Fifth intercostal drain on the left	Blood (200 ml) present in the pericardial sac

Hence, the quantities displayed in Figure 2 represent the overall collective number of injuries seen in a certain body region. Therefore, they do not equate to 100%. More than one body region was injured in 79 cases (46%), and the same body region was injured in more than 96 cases (56%) once. Overall, the thoracic cage sustained the most injuries. Collectively, 112 wounds were recorded in the chest area, which indicates that a SFI to this region was documented in 65% of the cases. One hundred and twelve wounds were present in 93 cases. The cause of death in 79 of the latter was recorded as a stab wound to the chest, and as a stab wound to the heart in 14 cases. Only six of these patients were admitted to hospital. Patients with 94% of the stab wounds in the chest died at the scene before the arrival of the emergency medical services. A summary of injuries to the chest (external and internal) is provided in Table 2 a and b.

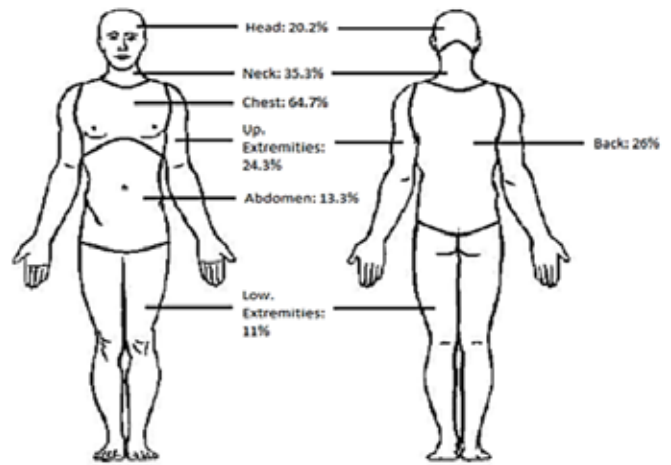


Figure 2: Distribution of sharp force injuries according to anatomical location

Table 2 a: A summary of external injuries to the chest

Intercostal space number	Anatomical area injured		
	Left	Right	Central (sternal)
1	6	3	–
2	15	9	1
3	13	2	2
4	13	2	3
5	14	1	2
6	6	1	–
7	6	1	–
8	3	1	–
9	1	1	–
10	1	–	–
> 1	20	–	–

Table 2 b: A detailed summary of internal injuries to the chest

Injuries to the chest	
Lung injuries	
Left lung upper lobe	11
Left lung lower lobe	30
Both lobes of left lung	3
Right lung upper lobe	4
Right lung middle lobe	6
Right lung lower lobe	12
> 1 lobe of the right lung	4
Heart injuries	
Left ventricle	31
Right ventricle	25
Interventricular septum	3
Apex	5
Left atrium	5
Right atrium	5
Pericardial sac	50
Blood in pericardial sac (including tamponade)	43
Heart valve	2
Injury to more than one area of the heart	55
Mediastinal injuries	
Surgical emphysema	12
Haemorrhage	35
Vascular injuries	
Pulmonary trunk	9
Aorta	16
Subclavian vein	4
Other arteries	11
Other organs injured	
Oesophagus	3
Diaphragm	2
Liver	2
Stomach	1
Trachea	1
Intestines	1
Upper limb	1
> 1 other organ injured (in the same patient)	2

Organs injured

The heart and the left lung represented the most predominantly damaged organs. Both of these were injured in 38% of all cases (Table 3). None of the organs were injured in 48 cases (28%), and more than one organ was perforated in 48 cases (28%).

Table 3: Organs injured

Organs injured	Overall number of wounds	Percentage of cases with trauma to this organ
Brain	4	2
Heart	65	38
Right lung	35	20
Left lung	65	38
Liver	6	4
Pancreas	0	0
Spleen	0	0
Right kidney	0	0
Left kidney	2	1
Other	10	6

Blood vessels injured

The majority of damaged blood vessels were in the neck. Forty-three persons (25%) reported perforations to vessels in this region (Table 4). None of the blood vessels were injured in 95 cases (52%), and more than one major blood vessel was punctured in 20 cases (11%).

Table 4: Major blood vessel injury

Major blood vessels in specifically injured body regions	Number of times a vessel in this region was injured	Percentage of cases with vessel damage in this region
Head	1	1
Neck	43	24
Thorax	40	22
Upper limbs	17	9
Abdomen	9	5
Lower limbs	4	2

Defensive wounds

The presence of defensive wounds was recorded in 55 of the 164 homicidal cases (32%).

Hesitation wounds and tentative cuts

There were six cases of suicide, with hesitation wounds reported in 3 of these (50%).

Alcohol concentration in the blood

This analysis was conducted on 166 cases (96%). Positive blood-alcohol concentration was reported in 109 individuals (66%). The concentration ranged from 0.01g/100ml to

0.35g/100ml blood. The average blood-alcohol concentration was 0.17g/100ml. It was illustrated in 57 cases (34%) that alcohol was not present in the decedent's blood.

Cause of death

The cause of death was articulated according to the injured body region (Figure 3). All of the subsequent causes of death included both the anterior and posterior aspects of that specific body area. The cause of death was formulated as a "stab wound to the chest" in 92 persons (53%), and "multiple stab wounds" in 16% ($n=27$) of the cases. The cause of death was not ascertained at autopsy in 2 fatalities (1%) due to severe post-mortem decomposition.

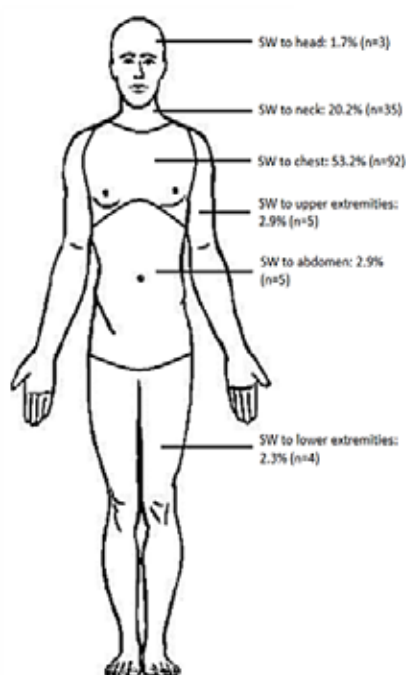


Figure 3: Cause of death according to body region

Mechanism of death (pathophysiological derangement resulting in death)

Ten mechanisms of death were identified from the case files (Table 5). Exsanguination was the most frequent (84%). The mechanism of death was not stated in eight cases, and more than one was recorded in 18 cases.

Manner of death

According to South African Law, the manner of death is a judicial finding, and is not determined by the forensic pathologist who conducts the post-mortem examination. The pathologist merely provides an opinion as to the manner of death upon completion of the post-mortem investigation. Of all the cases, 164 (95%) were ordained as homicide, 6 (4%) were determined to be suicide, 1 (1%) was accidental, and the manner of death could not be determined in 2 fatalities (1%).

Table 5: Mechanism of death

Mechanism of death	Percentage of cases
Exsanguination	84
Cardiac tamponade	5
Pneumothorax	8
Pulmonary embolism	2
Blood aspiration	1
Haemoperitoneum	2
Spinal injury	2
Brain injury	1
Disseminated intravascular coagulation	1
Pneumonia	1
Not stated	5

Discussion

It was indicated in our study that sharp force fatalities comprised 173 cases (5%) of total admissions to the Pretoria Medico-Legal Laboratory. This incidence is exceptionally high when the time frame and population size of Pretoria are factored in, in comparison to that internationally.^{6,10} Only 1 653 post mortems were performed in the same period in a similar study in Lahore, Pakistan, and 70 of the deaths (4%) were due to sharp force.⁷ Although this percentage is only slightly less than that in this study, the population size of Lahore is approximately 4.5 times greater than that in Pretoria. The male preponderance in this study was not in keeping with South Africa's overall gender distribution, in which females are slightly more dominant.¹¹ Conversely, this finding is congruent with that in similar research in which it was indicated that fatalities among males far surpassed those in females.^{10,12} The modal age group ranged from 21–30 years, which is consistent with that in previous reviews.^{13,14} In our study, 49 (28%) of the individuals received emergency care, but died at the scene. A further 27 (16%) persons were transported to hospital, but were declared dead on arrival. Further research is needed to evaluate the current level of care rendered by emergency medical services.

The association between high blood-alcohol concentration and interpersonal violence is well documented.^{15,16} This correlation was noted in this study, in which 66% of the decedents had a positive blood-alcohol concentration. A blood-alcohol test was not carried out at the time of the post-mortem examination in seven cases due to the long period of hospitalisation. The average concentration was 0.17g/100ml in those who tested positive, which can cause gross motor impairment, lack of physical control and an increase in aggressive behaviour, according to the Student Health Services.¹⁷

Similar results were illustrated in studies carried out by Racette et al. and Karlsson et al.^{8,18} There is still current debate on how to determine at what exact alcohol concentration

individual people can be classified as being “under the influence” or even “intoxicated”, since numerous variables need to be taken into account. Therefore, in some of the persons who had a relatively low blood-alcohol concentration, it was not known whether or not the alcohol consumption influenced that person’s behaviour. In the absence of clearly defined parameters, definite conclusions cannot be articulated in this regard. Additional research on this matter is required.

Most sharp force fatalities have been shown to have occurred in private homes and open lands in various international reviews.^{10,19} Informal settlements are a nationwide commonality in South Africa. These are clusters of dilapidated housing established in areas of land to which the occupants do not have a legal claim.²⁰ Violence, crime and poverty are everyday occurrences in informal settlements. The latter account for 13% of the places in which these fatalities took place in our study.

The thoracic area, including both the anterior and posterior aspects, was the most commonly injured anatomical region in our study. There was a strong correlation between this finding and the most frequent cause of death, of a “stab wound to the chest”. This anatomical body site was also reported to be the most injured in corresponding publications.^{12,19} Sixteen per cent of the injured persons died after being hospitalised in this review. Most of them sustained stab wounds to either the abdomen or upper or lower extremities. A similar study was conducted over the same period in Pietermaritzburg. However, the focus was on the trauma patients admitted to three hospitals in that area. The results indicated that 75% of the persons who received a stab wound to the chest died at the scene,²¹ compared to 94% with a stab wound to the chest who died at the scene in our study. Of these decedents, 35% had already survived ≥ 1 day in our study, with the leading mechanism of death being exsanguination.

The ratio of homicidal to suicidal sharp force fatalities observed in Pretoria is vastly skewed in comparison to that reported in international publications. Our ratio was approximately 27.0:1.0, which contrasts significantly with the research performed by Racette et al., Karlsson et al. and Brunel et al., where the ratios of homicidal to suicidal sharp force death were 2.6:1.0, 1.7:1.0 and 1.5:1.0, respectively.^{8,18,22} Not only did the homicidal incidence outweigh that of the suicides, it also immensely exceeded the global statistics of sharp force homicides. In 2013, sharp force violence accounted for 24% of homicides worldwide, while it contributed to 85% of assault deaths in South Africa.^{2,23}

Conclusion

The percentage of sharp force-related fatalities in Pretoria is exorbitant when compared to that in other global regions, where the studies took place over a considerably longer period and larger geographical area. Furthermore, the occurrence of sharp force homicides was found to be more frequent than that of suicide in our study.

It has been established on an international scale that the majority of sharp force homicides are the result of

stab wounds inflicted to the thoracic region of the body. Consequent perforation to the heart and lungs is immediately fatal. Further research is required into these troubling results, and in particular, with respect to the number of cases where SFIs to the abdomen and extremities still resulted in fatalities in patients who had been admitted to hospital for ≥ 1 day. It is surprising that these patients mostly succumbed to blood loss, bearing in mind that these patients were all admitted to hospitals in a large urban city in South Africa, where there would not have been a shortage of blood products.

An understanding of the magnitude of the problem, the anatomical regions injured, as well as the mechanisms of death in the patients admitted, could serve as a basis for an improvement to medical care. This might result in a reduction in the number of fatalities due to sharp force violence which occur in hospital settings.

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