ISSN 2073-9990 East Cent. Afr. J. surg

Analysis of Soft Tissue Injuries and Scarring Following Terrorist Bomb Explosion at the American Embassy in Nairobi, Kenya.

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Background: ***This retrospective observational descriptive study was aimed at determining the pattern of soft tissue injuries and subsequent scars that followed the American Embassy Terrorist Bomb Explosion in Nairobi.***
Methods: ***The study was undertaken at Kenyatta National Teaching and Referral Hospital (KNH), Nairobi. All patients attended to at KNH who were victims of the terrorist Bomb Explosion at the American Embassy in Nairobi an.***
Intervention: Conservative and operative intervention.
Main Outcome: Scarring.
Results: ***1471 patients were treated at the Kenyatta National Hospital 646 in the first 24 hours and 825 in the screening and reconstructive periods. 54% were males. 83% were treated and discharged. 71% were between the ages of 20 and 40 years. 73% of the patients had soft tissue injuries mostly in the extremities. Abnormal scar formation was the commonest complication of the injuries.***

Key words: bomb blast, injuries, scarring

Introduction

Although this event took place in 1998 the authors felt that the data collected on soft tissue injuries and scarring should be published in order to allow researchers to compare and contrast these injuries and outcomes with other similar events. It would also assist in some way to increase understanding of this type of event and perhaps be a factor in Disaster management planning.

The terrorist bombing of the American Embassy on August 7th 1998 was the single worst terrorist bombing experience in Kenya's History. It also affected neighboring buildings such as the Co-operative Bank and Ufundi House buildings. The dual explosion left 213 dead and scores more injured.

Patients and Methods

This was a retrospective descriptive observational study. All patients that were injured in the bomb explosion, suffered soft tissue injuries and were treated at KNH were Eligible for inclusion into the study. Data was collected from hospital medical records and from records of the rehabilitation team co-ordinated by Kenyatta National Hospital in conjunction with the United States Agency for International Development (USAID) and the African Medical and Research Foundation (AMREF) using structured questionnaires. This data was subsequently analyzed using SPSS statistical package software.

In this study physical injury was defined as any blunt or penetrating trauma resulting from the primary blast injury including thermal and inhalation burns and tympanic membrane rupture.

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Results

A total of 1471 persons injured during the August 1998 bomb blast were treated at the Kenyatta National Hospital; 646 within the first 24 hours after the blast and the remaining 825 during the screening and reconstruction period (Table 1). There was a predominance of males 801 (54.5%), compared to females 669 (45.5%); similar to the gender profile of Nairobi province where 53.83% of the population is male and 46.13% female.[34] There was one person whose gender was not indicated(Table 2).

The majority (71%} were aged between 20 and 40 years. A total of 73% of the patients had soft tissue injuries mostly in the extremities. Abnormal scar formation was the commonest complication of the injuries. Of the survivors, 58.5% were first seen in Kenyatta National Hospital and the hospitals around it. Of these patients 83% were treated and discharged. Glass shrapnel was the main cause of injuries accounting for 63% of the injures (Table 1). There were three children below the age of 10 years. The majority of victims

Table 1. Causes of the Injuries

Cause	Frequency	Percentage
Glass shrapnel	987	63.0%
Collapse of building	52	3.3%
Fall from heights	55	3.5%
Not specified	473	30.2%
Total	**1567**	**100.0%**

Of those admitted in KNH, 14 were to intensive care, while the remaining 97 were admitted to the emergency ward. The criteria for admission was not clear, though the main reasons for admission were; eye injury requiring surgical intervention or slit lamp examination 18, musculoskeletal injuries requiring surgery 16, anemia following hemorrhage from external wounds 6, other causes 55 (Table 6a). Of those admitted to intensive care, 12 had head injury, while the other 2 had chest injuries requiring assisted ventilation. Seven of the patients admitted with head injuries died, 2 of them within 4 hours of admission.

The two persons admitted with chest injuries survived. No patient was diagnosed with blast lung, possibly because of the difficulty in diagnosing it.[8] Because post-mortems were not performed on all those who died at the site, it is unclear how much chest injury could have contributed to mortality. Seven of the patients with head injury had intracranial bleeds, 4 of them associated with compound depressed skull fracture. One of these patients had foreign bodies embedded in the brain substance. They all underwent surgery; the postoperative mortality was 3.

Two out of 3 patients with severe head injury with no intra cranial bleed died. The remaining 535 people seen had lacerations and cuts of various sizes and locations in the body. In 332 of cases, the wounds were cleaned and sutured immediately under local anesthesia while in 162 persons; the wounds did not require suturing. These were cleaned with antiseptic and dressed. They were advised to have the wounds dressed in a facility near their residence. Ten patients had wounds that were grossly contaminated with dust, pieces of clothing and glass fragments. The skin cleaned with detergent antiseptic (savlon), before exploration under local anesthesia. All foreign material, dead and contaminated tissue was removed, and then the wound was lightly packed and inspected after 3 – 5 days.
Five were sutured between the 5th and 7th day (delayed primary suturing) while the remaining 5 were sutured later (secondary suturing). No wound required skin grafting. The patients also

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received tetanus prophylaxis and oral antibiotics. The antibiotic prescribed was either Ampiclox or Ampicillin.

Table 2. Treatment Given at KNH for Patients who sustained Soft Tissue Injury

Treatments	Frequency
Cleaned and dressed	162
Cleaning and primary stitching	332
Cleaned, dressed then delayed primary suturing	5
Cleaned, dressed and secondary suturing	5
Not specified	31
Total	**535**

Like in other terrorist bombings[1,4], soft tissue injuries (lacerations, abrasions, contusions and puncture wounds) were the most common injury (72.8%) in the 1464 survivors, followed by eye (17%) and musculoskeletal (6.1%) injuries consecutively. Ear injuries were seen in only 3% of the survivors.

In all, 73% of patients had soft tissue injuries. Among the 1197 persons with soft tissue injury, the most common location was the extremities[1, 4] (40.2%). In spite of the small body surface area they occupy, soft tissue injury of the face and the scalp occurred in 38.9% of the survivors. The severity of soft tissue injury was not indicated. Some patients had injuries at more than one location. More males sustained injuries to the face (425) and scalp (112), compared with females (388 and 57) respectively. Conversely, more females (327) had lower limb soft tissue injury compared with their male (192) counterparts. The occurrence of soft tissue injury to the trunk was similar in both sexes.

The upper limb, chest, abdomen and back were affected in relatively equal proportions in both sexes. The distribution of these injuries in relation to the regions of the body suggested the protective value; of trousers in men to the lower limbs, and headgear in females to the head. [1,4]

Table 3. Regional Distribution of Soft Tissue Injuries

Site	Male	Female	Total	% of Total
Face	425	388	813	32.2%
Scalp	112	57	169	6.7%
Neck	48	98	146	4.5%
Lower Limbs	192	327	519	20.6%
Upper limbs	239	255	494	19.6%
Chest	103	114	217	8.6%
Abdominal wall	47	27	74	2.9%
Back	51	38	89	3.5%
TOTAL	**1217**	**1304**	**2521**	**100.0%**

SEX DIFFERENCE IN REGIONAL DISTRIBUTION OF SOFT TISSUE INJURY

Abnormal scars as a consequence of soft tissue injury occurred in 69.8% of the survivors who sustained neck injuries and 62% of those who had soft tissue injury to the head. The back, abdomen and upper limbs had less than 40% of the survivors with soft tissue injury developing abnormal scars. For all sites, hypertrophic scars accounted for more than 66% of the abnormal scars, followed by keloid, accounting for 19% to 33%. The highest occurrence of hypertrophic scars was in the scalp (81%) and lower limbs (81%), followed by the face (75.8%), upper limbs (77%) and back (75%). The highest tendency to form keloids was in the chest where 32.8% of the abnormal scars were keloid, followed by the neck (27.5%), abdomen (26.7%). Back (25%)

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and upper limbs (22.5%) respectively. The scalp and face accounted for the lowest occurrence of keloids (Table 4).

Table 4. Regional Distribution of All Scars

	Face	Scalp	Neck	Lower Limb	Upper Limbs	Chest	Abdomen	Back
Normal	308	90	44	319	290	101	44	57
Abnormal	505	79	102	200	204	116	30	32
Total	813	169	146	519	494	217	74	89

Table 4. Regional Distribution of abnormal Scars

	Face	Scalp	Neck	Lower Limbs	Upper Limbs	Chest	Abdomen	Back
Broad	3 0.6%	0 0.0%	0 0.0%	0 0.0%	1 0.5%	1 0.9%	0 0.0%	0 0.0%
Hypertrophic	383 75.8%	64 81.0%	74 72.5%	162 81.0%	157 77.0%	77 66.4%	22 73.3%	24 75.0 %
Keloid	111 22.0%	14 17.7%	28 27.5%	38 19.0%	46 22.5%	38 32.8%	8 26.7%	8 25.0 %
Trap Door	7 1.4%	0 0.0%	0 0.0%	0 0.0%	0 0.0%	0 0.0%	0 0.0%	0 0.0%
Atrophic	1 0.2%	1 1.3%	0 0.0%	0 0.0%	0 0.0%	0 0.0%	0 0.0%	0 0.0%
Total	**505**	**79**	**102**	**200**	**204**	**116**	**30**	**32**

The treatment given for hypertrophic scars at various sites was varied, but the majority of patients had excision of scar alone. Scars were mainly revised for cosmetic reasons. Out of 430 people with hypertrophic scars on the face, 52.1% had excision only, and only 20.2% had excision followed by radiotherapy. 10.9% had Z-plasty.

The 64 patients with hypertrophic scars on the scalp were mainly treated by steroid injections (31.3%), excision (29.7%) and pressure garments (21.9%). As shown in Table 5, 37.8% of the people with hypertrophic scars in the neck had Z-plasty scar revision, 27% excision followed by radiotherapy and 21.6% excision alone. Most of the patients (60.5%) with hypertrophic scars in the lower limbs were left alone, while (24.1%) were put on pressure garments. 39.5% of the 157 patients with hypertrophic scars in the upper limbs had them excised, while 28.7% were given pressure garments. 81.9% of the 77 patients with hypertrophic scars on the chest had excision of the scars, 44% of these were followed up with steroid injections and 31.7% radiotherapy.

Most of the hypertrophic scars on the back (33.3%) and the abdomen (36.4%) were left along while 25% and 36.4% respectively were excised and injected with steroid. The method of scar revision was as varied as the surgeons who operated on the patients. Suffice to note; general and orthopaedic surgeons carried some of the operations out.

All the 111 patients with keloid scars on the face had them excised (Table 6); 104 (93.7%) of them had radiotherapy, and the remaining (6.3%) received steroid injections, in keeping with the common practice in KNH. Excision and radiotherapy was performed for most of the keloids at other sites; scalp (50%), neck (64.3#), chest (68.4%), upper limb (65.2%) and lower limb (47.4%) respectively (Table6). Twelve (75%) of the 16 patients with keloids on the back and

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abdomen had steroids and excision only while the rest (25%) were left alone. In 14) 36.8% of the 28 patients, the lower limb keloids were left alone

Table 5. Distribution of Treatment Modalities of Hypertrophic Scars by Numbers and Percentage

	Face	Scalp	Neck	Lower Limp	Upper Limb	Chest	Abdomen	Back
Excision Only	224 52.1%	19 29.7%	16 21.6%	22 13.6%	62 39.5%	20 26.0%	0 0.0%	6 25.0%
Excision & Radioth.	87 20.2%	0 0.0%	20 27.0%	0 0.0%	24 15.3%	28 36.4%	0 0.0%	0 0.0%
Excision &. Steriods	20 4.7%	2 3.1%	6 8.1%	3 1.9%	2 1.3%	15 19.5%	8 36.4%	6 25.0%
Steriod only	0 0.0%	20 31.3%	2 2.7%	0 0.0%	0 0.0%	6 7.8%	6 27.3%	4 16.7%
Pressure Garment	48 11.2%	14 21.9%	0 0.0%	39 24.1%	45 28.7%	0 0.0%	0 0.0%	0 0.0%
Left Alone	4 0.9%	6 9.4%	2 2.7%	98 60.5%	24 15.3%	8 10.4%	8 36.4%	8 33.3%
Z-Plasty	47 10.9%	3 4.7%	28 37.8%	0 0.0%	0 0.0%	0 0.0%	0 0.0%	0 0.0%
Total	**430**	**64**	**74**	**162**	**157**	**77**	**22**	**24**

Table 6. Distribution of Treatment Modalities of Keloids by Numbers and Percentage

	Face	Scalp	Neck	Lower Limb	Upper Limb	Chest	Abdomen	Back
Excision & Radio.	104 93.7%	7 50.0%	18 64.3%	18 47.4%	30 65.2%	26 68.4%	0 0.0%	0 0.0%
Excision & Steriods	7 6.3%	1 7.1%	5 17.9%	4 10.5%	4 8.7%	5 13.2%	6 75.0%	6 75.0%
Excision only.	0 0.0%	4 28.6%	2 7.1%	2 5.3%	10 21.7%	3 7.9%	0 0.0%	0 0.0%
Left Alone	0 0.0%	2 14.3%	3 10.7%	14 36.8%	2 4.3%	4 10.5%	2 25.0%	2 25.0%
Total	**111**	**14**	**28**	**38**	**46**	**38**	**8**	**8**

Most of the injuries sustained by the survivors were caused by glass and flying debris and were minor soft tissue injuries that required outpatient treatment; cleaning and dressing; suturing in the casualty department or minor theatre; oral antibiotics and tetanus prophylaxis. These injuries were commoner in exposed areas of the body, such that more males sustained soft tissue injury to the face compared with the females, where as more females had lower limb injuries. The regional distribution of the injuries suggests the protective role of clothing and headgear[1, 4]

Abnormal scar formation was the commonest complication following these injuries, with hypertrophic scars accounting for more than 66% of them. Scar revision was performed in 80% of the hypertrophic scars on the face and scalp, as compared with less than 75% for scars on the trunk and the extremities. Most of this was fusiform scar revision (excision). The method of

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scar revision was varied considering that some of the physicians performing the operations were not specialists in plastic and reconstructive surgery.

Keloids accounted for less than 32% of the abnormal scars. All the keloids occurring on the face were excised and then followed up with superficial radiotherapy in 95% of the cases, the remaining 6% receiving steroid injections.

Discussion

Flying debris and shrapnel caused most of the injuries. The injured sustained mainly soft tissue injuries that were treated on an outpatient basis. The regional distribution of soft tissue injury suggests the protective role of clothing and headgear[1, 4]. Scars; keloids and hypertrophic scars, were the commonest complication following these injuries. Scar management formed the bulk of work during the reconstruction period.

Only 17.2% of the blast victims at KNH were admitted, while the remaining were treated and discharged. Similarity is drawn with the Belfast[1] and Oklahoma[4] bombings where 14% and 16% of the victims were admitted respectively. Terrorist bombings are ugly acts of modern life that are widely distributed the world over. The August 7th bombing of the American Embassy in Nairobi; which also affected the neighbouring Co-operative and Ufundi House buildings was the worst experience Kenya has so far had with terrorism. The dual explosion injured civilians and non-suspecting rescuers, leaving 213 dead, and many more injured at site with a massive scale of confusion.

Understanding the epidemiology of the injuries sustained, and the accompanying complications are imperative in efforts to save lives and reduce morbidity should future bombings occur. A total of 1471 persons were seen at Kenyatta National Hospital due to injuries following the August 7th bomb blast. 56% of these were seen for the first time during the reconstruction period, having been treated at private hospitals and clinics immediately after the blast. It affected both males and females from the most productive age group in the society, hence the major economic implications.

Most of the injured were rapidly evacuated from the site to hospitals by civilians in private and public transport vehicles, most of them landing in the public hospitals. Those performing the initial evacuation did it at random as they lacked proper co-ordination and first aid knowledge. Most of the injuries sustained by the survivors were caused by glass and flying debris, and were minor soft tissue injuries that required outpatient treatment; cleaning and dressing; suturing in the casualty department or minor theatre; oral antibiotics and tetanus prophylaxis. These injuries were commoner in exposed areas of the body, such that more males sustained soft tissue injury to the face compared with the females, where as more females had lower limb injuries. The regional distribution of the injuries suggests the protective role of clothing and headgear[1, 4]

Abnormal scar formation was the commonest complication following these injuries, with hypertrophic scars accounting for more than 66% of them. Scar revision was performed in 80% of the hypertrophic scars on the face and scalp, as compared with less than 75% for scars on the trunk and the extremities. Most of this was fusiform scar revision (excision). The method of scar revision was varied considering that some of the physicians performing the operations were not specialists in plastic and reconstructive surgery. Keloids accounted for less than 32% of the abnormal scars. All the keloids occurring on the face were excised and then followed up with superficial radiotherapy in 95% of the cases, the remaining 6% receiving steroid injections. Patients were admitted mainly for injuries that required specialized examination and treatment or surgical correction in the main theatre. This included eye injuries, and extensive musculoskeletal injuries. Skeletal injury was not common, affecting only 6% of the survivors.

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Most of the fractures involved the long bones of the upper and lower limbs in relatively equal proportions. Most of these were treated conservatively with relatively good outcome. Among those who died in hospital, 7 out of 8 died from severe head injury. All the deaths occurred within 12 hours of admission onto hospital.

Conclusion

Despite the fact that explosions vary greatly in the numbers of victims they claim and the nature of injuries they inflict, several general conclusions may be drawn:

1. The majority of patients sustained minor soft tissue injuries, mainly caused by flying glass and debris and may be treated as outpatients.
2. Injuries predominantly affect the head and neck and peripheries, suggesting that clothing has a protective role[8]
3. Although injuries to the chest and abdominal organs are uncommon after explosions, they are associated with a high morbidity.
4. Primary blast injuries to the lungs are infrequently seen in survivors[8]. It is possible they may be responsible for some deaths occurring before the victims arrive in hospital.
5. Scars are the most frequent complication following blast injury and so form the bulk of work during reconstruction.

Both public and private medical care delivery institutions were involved in looking after the blast victims especially in the acute stage. All healthcare delivery institutions should therefore be well equipped and stocked to enhance preparedness in the event of similar disasters.
Apart from treating physical injuries and their associated complications, much attention should be directed to the mental health consequences for all persons directly involved in the blast, especially those with disabling, disfiguring injuries.

Disaster training and practice with procedures such as drills and mock ups should be encouraged to increase preparedness and reduce mortality and morbidity in these unfortunate traumatic incidents.

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