

Patterns of Injury in Hospitalized Terrorist Victims

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Acts of terror increase the demand for acute care. This article describes the pattern of injury of terror victims hospitalized at 9 acute-care hospitals in Israel during a 15-month period of terrorism. To characterize patients hospitalized as a result of terror injuries, we compared terror casualties with other injuries regarding severity, outcome, and service utilization. Using data from the National Trauma Registry, characteristics of casualties are portrayed. During the study period, 23,048 patients were recorded, 561 of them (2.4%) were injured through terrorist acts. Seventy percent were younger than 29 years. Seventy-five percent were males. Thirteen percent of terror victims compared with 3% with other traumatic injuries, arrived by helicopter. Injury mechanism consisted mainly of explosions (n = 269, 48%) and gunshot injuries (n = 266, 47%). One third of the population experienced severe trauma (Injury Severity Score \geq 16). One hundred-forty-two patients (26%) needed to be admitted to the intensive-care unit. Inpatient mortality was 6% (n = 35). Fifty-five percent of the injuries (n = 306) included open wounds and 31% (n = 172) involved internal injuries; 39% (n = 221) sustained fractures. Half of the patients had a procedure in the operating room (n = 298). Duration of hospitalization was longer than 2 weeks for nearly 20% of the population. Injuries from terrorist acts are severe and impose a burden on the healthcare system. Further studies of the special injury pattern associated with terror are necessary to enhance secondary management and tertiary prevention when occurring. (*Am J Emerg Med* 2003;21:258-262. © 2003 Elsevier Inc. All rights reserved.)

Terrorism has been defined as all criminal acts directed against a state and intended or calculated to create a state of terror in the minds of particular persons or a group of persons or the general public.¹ In Israel, death and injury resulting from acts of terrorism have escalated in the past 15 months, increasing demands and varying the casemix balance attended to at acute-care hospitals. In the period extending from September 29, 2000, to December 31, 2001, terrorist acts claimed over 250 lives, and caused 2,022 injuries.² One in every 26,392 Israelis have been killed by

terrorist acts in the first 6 months of 2002.³ Morbidity and residual disability are becoming a growing burden both on the healthcare system and on society as a whole. Using data based on the National Trauma Registry, distribution and characteristics of injuries in hospitalized patients were examined and the influence of some unique offending weapons were reviewed. Casualties arrived with a variety of injuries, including gunshot wounds, stab wounds, explosion injuries, burns, and nontypical injuries caused by the penetration of nails, bolts, metal balls, or other sharp objects driven by explosives.

This article provides a description of injury pattern among terror victims hospitalized at 9 acute-care hospitals in Israel during the first 15 months of the Israeli-Palestinian conflict.

AIMS

1. To characterize patients hospitalized as a result of injuries caused by terrorist acts.
2. To compare the pattern of terrorist act casualties with other trauma victims in terms of severity, outcome, and service utilization.

METHODS

This study is a retrospective cohort study of all people injured through terrorist acts (external cause of injury E990-E998 and selected cases from E970-E978) from September 29, 2000 (the day the riots began) to December 31, 2001, and recorded in the Israeli National Trauma registry (ITR).

Included in the ITR are all casualty admissions to hospitals, in-hospital deaths, and transfers to another acute-care hospital at 9 of 23 trauma centers in Israel. The 9 hospitals include all 6 level 1 trauma centers in Israel and 3 of the largest regional trauma centers in the country. Hospitals participating in the ITR admit the majority of severe trauma victims in Israel. Data on the nature of injuries, treatment, and outcome were obtained from the registry. Medical diagnoses were extracted from the registry and classified based on International Classification of Diseases, 9th Revision, Clinical Modification, coding. Diagnoses were grouped to body regions and internal injuries were identified based on the Barell Injury Diagnosis Matrix.⁴ SAS statistical software (SAS, Cary, NC) was used for the statistical analysis and comparison between groups. Statistical analysis included conventional tests such as Pearson χ^2 for categorical data, t-tests for continuous variables, and Wilcoxon nonparametric tests when continuous variables did not distribute normally. A value of $P < 0.05$ was considered statistically significant.

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TABLE 1. Age Distribution of Terror Victims Compared with Other Etiologies of Trauma

Total No.	Terrorism 553	Other Trauma 22,302
Age group*	Percent	Percent
0-14	8.1	30.3
15-29	61.7	22.8
30-44	17.9	13.8
45-59	9.0	9.7
60+	3.3	23.5

A total of 193 (0.8%) missing.

*Differences are statistically significant at the $P < 0.001$ level.

RESULTS

Population

Terrorist acts were aimed mostly at a civilian population and took place in the form of explosions where people congregate, for example, in restaurants, wedding halls, discos, and so on, or while commuting (gunshot wounds). During the study period, 23,048 patients were recorded into the trauma registry, 561 of them (2.4%) had e-codes indicating injury through terrorist acts. The population injured by terrorist activity was young, with 61% between the age of 15 and 29 years compared with 23% in this age group among the population injured by other trauma (Table 1). There was a male predominance in the population ($n = 418$, 75%). Soldiers in conflict areas are mostly males in their early 20s, and 19% of the population were comprised of soldiers. However, not all of them were injured on duty as some of them were injured while on leave or while commuting through civilian areas. Additionally, male predominance was consistent when excluding soldiers from the population.

Arrival to the Hospital

Overall, patients injured in terrorist activity were more likely to arrive by ambulance. Four hundred thirty-five patients (84%) with terror injuries, compared with 10,606 (54%) with other types of trauma, had arrived by ambulance. However, because these patients were more severely injured, their condition often necessitated the use of ambu-

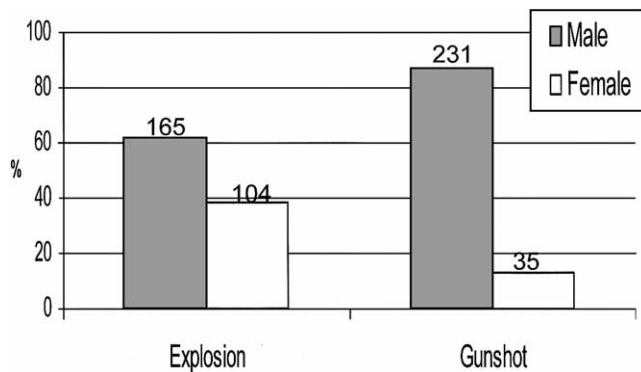


FIGURE 2. Distribution by gender of injury mechanism.

lance evacuation, whereas for patients with less severe injuries, ambulance transport was not necessary. This comparison was therefore carried out for patients with severe injuries separately Injury Severity Score ([ISS] ≥ 16). In this population, the use of ambulance by terror and nonterror casualties was similar, at nearly 84% for nonterror and 86% for terror victims, whereas the difference is noted in self-transport, which applied to 13% of nonterror patients and only 1% of terror patients. Helicopter was the mode of arrival for 13% ($n = 20$) of terrorism victims compared with 3% ($n = 58$) with other traumatic injuries (Fig 1).

Injury Mechanism

The injury mechanism consisted of explosions (48%, $n = 269$), gunshot injuries (47%, $n = 266$), and other or unknown means (5%, $n = 26$), which included stabbing, rock throwing, and intentional running over with motor vehicles. Males were more frequently injured by gunshot (Fig 2).

Injury Severity

Thirty percent of the population injured in terrorist activities and admitted to the hospital experienced severe trauma (ISS⁵ ≥ 16). The proportion of injuries with an ISS ≥ 16 in the terror-afflicted population was much higher than that of the nonterror-related trauma population. When excluding road traffic accidents from other trauma, 30% of terror

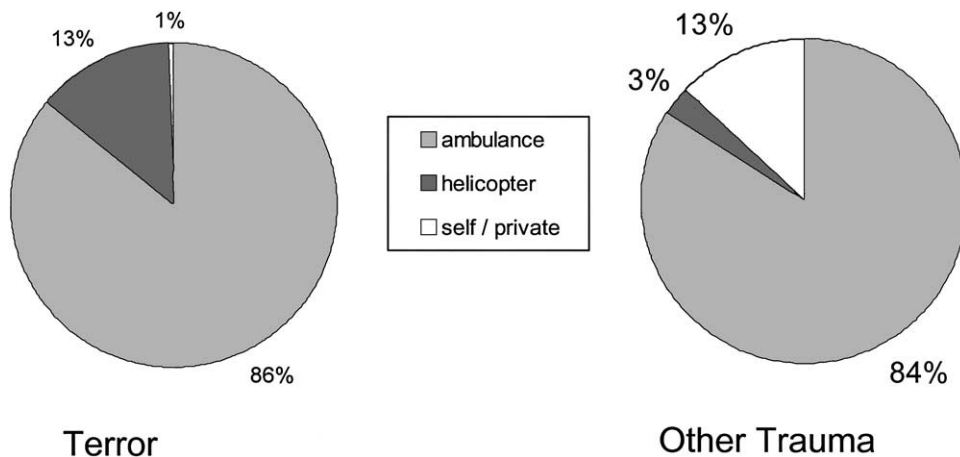


FIGURE 1. Mode of evacuation to hospital for patients with ISS ≥ 16 .

TABLE 2. Comparison of Injury Severity and Mortality of Terrorism Victims With Other Trauma Casualties

	Terrorism	Road Traffic	Other Trauma
Total No.	561	5,575	16,912
ISS >16*	30.5%	19.6%	7.7%
Inpatient death*	6.2%	3.0%	1.8%

*Differences are statistically significant at the $P < 0.001$ level. Abbreviation: ISS, Injury Severity Score.

victims, 20% in motor vehicle accidents, and 8% from "other trauma" had an injury of ISS ≥ 16 (Table 2).

Intensive-Care Unit

Overall, 142 (26%) of the terror population had been admitted to the intensive-care unit (ICU) (Fig 3). ICU stay varied from a minimum of 1 day to a maximum of more than 2 months with a median of 4 days and an interquartile range of 2 to 11 days. Explosion injuries stayed longer in the ICU with a median of 6 days compared with gunshot wounds which had a median of 4 days.

Inpatient Mortality

Thirty-five patients died in the hospital (6%). This percentage is twofolds higher than inpatient death in road traffic casualties and threefolds higher than other trauma in the ITR (Table 2). Within the terror population, inpatient death toll was higher among gunshot wounds ($n = 22$, 8%) compared with 11 patients (4%) in explosion injuries ($P < 0.001$). Death occurred within the first 24 hours of hospitalization in 80% of those terror victims who died in the hospital compared with 34% in other etiologies ($P < 0.001$).

Nature of Injury

Three hundred six patients (55%) sustained open wounds and 172 (31%) involved internal injuries; 221 (39%) had fractures.

Body Region Injured

Overall, 266 of the injuries (47%) involved the head or neck. These included 110 single injuries to the head or neck (20%), 58 injuries to the head/neck and extremities (10%), 27 injuries to the head/neck or to the torso or head, and 29 to the neck torso and extremities (5% each). Of the 211 patients (38%) who had injuries to the torso, one third ($n = 63$) were isolated injuries. Extremities were the overall most common affected body region ($n = 309$, 55%). Forty percent of this population ($n = 125$) involved only extremities and the rest had other injuries as well. The most severe injuries were multiple trauma to the head/neck and torso, in which 18 patients (67%) had an ISS ≥ 16 . Six patients in this group died (22%).

Internal organ injuries were more severe than other injuries. Of the 172 patients with internal injuries, 111 patients (64%) had an ISS ≥ 16 . Nearly half of the patients with internal injuries sustained an injury to the chest ($n = 84$, 49%). Fifty-three patients (63% of chest injuries) had been

injured in the chest only and 31 patients (37% of chest injuries) had sustained injuries to the head and/or abdomen as well. Sixty-two patients (36%) had injuries to the head, 53 of them (85% of head injuries) had only the head injury and 9 patients (15% of head injuries) had head injuries that included another body region. This information is summarized in Table 3. In general, the severity of internal injuries was high. The most severe injuries were in the multiple, "head and other" group, nearly 80%, and in the "chest and abdomen" group, 75% had an injury with ISS ≥ 25 . Nearly 60% of patients with head and other injuries and almost half among abdominal injuries stayed in the hospital for more than 2 weeks. Seventy-eight percent in "head and other" injuries needed intensive care, as did 63% of patients with multiple "chest and abdominal" injuries. Inpatient death rate was again high for all internal injuries, but the highest inpatient death rate appeared in the group with injuries to the head and other body region in which nearly half of the patients died (4 of 9 patients in this group).

Internal injuries caused by bullets involved the chest (37%), the abdomen (31%), or both (12%). Internal injuries caused by explosions involved mainly the head (43%), the chest (25%), or both (8%).

Surgical and Other Procedures in the Operating Room

More than half of the patients had a surgical procedure in the operating room ($n = 298$, 53%) (Fig 3). This proportion was much higher in terrorism victims than in other forms of trauma admissions ($n = 8,742$, 39%). Within the terror-injured population, surgery was more commonly needed for those with gunshot wounds in which 155 patients (58%) had surgery compared with 128 (48%) in explosion injuries.

Duration of Hospitalization

Duration of hospitalization was longer than 2 weeks for nearly 20% of the population (Fig 3). The median duration of hospitalization was 5 days (IQR 2-11 days) compared with 3 days (IQR 1-7) involving other types of trauma (Wilcoxon $P < 0.001$).

DISCUSSION

A remarkable number of Israelis have been directly affected by terrorist acts in the past 2 years. Whether killed,

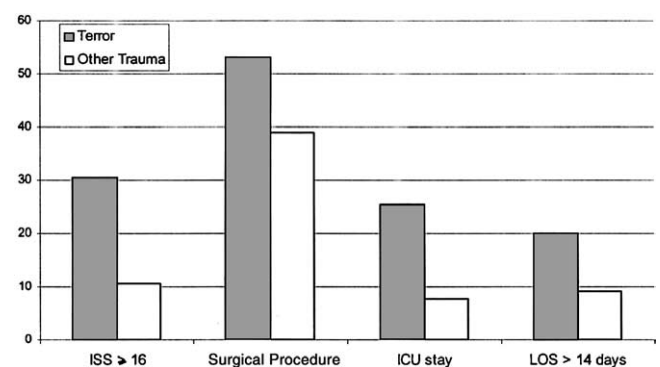


FIGURE 3. Utilization indicators of terror victims compared with other causes of trauma.

TABLE 3. Internal Injuries, Body Region Combinations, and Severity and Treatment Indices

Body Region	Total		ISS ≥25 in Group	Inpatient Death	Surgical Procedure	Los >14 Days	Intensive Care
	No.	Percent	Percent	Percent	Percent	Percent	Percent
Total	172	100	43.6	14	63.4	32.5	50.0
Head	53	30.8	26.4	15.1	37.7	13.5	41.5
Chest	53	30.8	39.6	9.4	60.4	30.2	47.2
Abdomen	33	19.2	45.5	9.1	81.8	48.4	51.5
Chest & abdomen	24	14.0	75.0	16.7	91.7	33.3	62.5
Head & other*	9	5.2	77.8	45.0	88.9	58.3	77.8

*Other included 5 patients (2.9%) with head & chest, 2 patients each (1.2%) with head & abdomen and head chest & abdomen. Abbreviation: ISS, Injury Severity Score.

injured, or just mentally distressed from witnessing the horror or the fear of it happening, hardly anyone is left untouched. While trauma in general is a disease of the young, terrorist acts in Israel seem to affect even the younger population. The population hospitalized as a result of terrorist attacks in Israel has a median age of 21 years, significantly younger than casualties of previously known trauma types. This could partly be explained by the location of many of the acts in restaurants, discos or other social meeting places and partly by the presence of young people, soldiers, or activists in the front line. The latter could to some extent explain the male predominance of gunshot injuries. However, exclusion of soldiers from the analysis revealed that male predominance persists, possibly reflecting excess commuting through conflict areas by males. Explosions in mass-gathering setups usually affect a large population, thus, although gunshot incidents occur more often, half of the population had injuries caused by the explosion mechanism.⁶

In-hospital fatality rates were significantly higher in victims of terrorist acts than in other forms of trauma. This is also similar to the pattern of death described for war fatalities.⁷ High-energy metal debris, blast and bullets aimed by snipers to vital body organs, all explain these dire consequences of terror attacks. Indeed a high proportion of bullets involved the chest (37%), the abdomen (31%), or both (12%).

Severity of injury and the circumstances and location in which it occurs influence the mode of medical evacuation in Israel. Among severely injured patients (ISS ≥16), 13% were evacuated by helicopter versus less than 3% with other etiologies of trauma ($P < 0.001$). The presence of military forces in these areas could be a factor in the increased use of air evacuation. Because all helicopters used for evacuation in Israel belong to the Air Force, the military has a higher awareness and expertise in using them for evacuation. In general, in mass casualty events, the large number of casualties often warrants the use of helicopters for medical evacuation. An additional use of helicopters is for secondary triage to bring the right patient to the most appropriate trauma center for his injury. Previous studies of mass casualties in Israel reported 7.3% of interhospital transfer after initial evacuation to the hospital.⁸

The complexities and extent of injuries included a need

for a greater extent of resources than those that are used in other forms of trauma. Median length of hospital stay was 5 (range, 2-11) days versus 3 (range, 1-8) days; length of stay in the ICU was 4 (range, 2-11) days versus 3 (range, 1-9) days. Thirty-nine percent of the patients with other trauma had surgery versus 53% for terror victims. Internal injuries refer to penetrating or blunt injuries which damaged internal organs, in the abdomen, chest, or intracranially. These injuries involve more threat to life than injuries to the extremities, severe as they may be. This carries implications in terms of duration of hospitalization, length of stay in the ICU, and inpatient death rates. As a result, mortality from terrorist attacks is much higher than mortality among other trauma, because the proportion of penetrating internal injuries in this population is much higher.

The penetrating wounds produced by random fragmentation munitions produce multiple wounds, frequently clustered.⁹ The literature reports variable results on the outcome between gunshot wounds and shell injuries. Branvold et al¹⁰ reports significant increased mortality among patients with gunshot wounds. Aarbi¹¹ reports no statistically significant difference in outcome.

Terror victims sustain more severe injuries when compared with other forms of trauma. Their resource utilization is higher in terms of duration of hospitalization, procedures carried out in operating rooms, intensive-care treatment, and so on, especially when penetrating wounds occur, elevating the cost of their treatment. Although the proportion of these patients in the overall population is small, the accumulated workload they create is extensive. Additionally, terror victims are younger, implying a greater loss of potential healthy life years and potentially longer disabled lives. This extra demand on resources created by terrorist victims is a burden not only on the health care system, but on society as a whole.

Terror is a unique form of severe intentional injury and presents with unique epidemiology.¹² Further studies of these special forms of injury patterns, its extent and anatomic distribution will enhance secondary management and tertiary prevention, when occurring.

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