Applying Lessons from Medical Management of Conventional Terror to Responding to Weapons of Mass Destruction Terror: The Experience of a Tertiary University Hospital

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This article aims to summarize the accumulating experience of Hadassah University Hospitals in Jerusalem, Israel with ongoing terror attacks. The authors review their ongoing documented data from the first two years of the last wave of Palestinian terror attacks. Injury patterns and epidemiology of 1,916 terror victims are analyzed. The main finding is that terror is associated with significantly more severe and resource-demanding injuries than other forms of trauma. Main lessons and conclusions from managing this terror wave are presented. The authors believe that preparedness and application of lessons learned from conventional terror will enhance the durability of society against terror associated with weapons of mass destruction.

The latest wave of Palestinian riots and terror acts began on 29 September 2000, and has been ongoing for the past 27 months. During this period, as of 28 December 2002, 4,910 Israelis were injured and 694 killed; of these 3,478 and 481 respectively were civilians. Medical authorities in Israel have gained a large degree of experience in the management of terror injuries and that of terror-related Mass Casualties Incidences (MCIs). Hadassah's two medical centers in Jerusalem have treated approximately 40% of this population and therefore have been exposed to a higher number of victims than any other single institute in the country. We at Hadassah have continuously gathered the data related to terror victims and have run periodical medical and managerial debriefing meetings. The authors feel that managerial lessons gleaned from dealing with conventional armament terror can be applied to terror assaults involving weapons of mass destruction (WMD).

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Methods and Data Resources

Hadassah Medical Organization possesses two university hospitals in Jerusalem: Hadassah Ein-Kerem is a 750-bed tertiary referral medical center. This campus encompasses all medical fields, including the only Level I Trauma Center in the Jerusalem region. (A Level I Trauma Center is part of a hospital that has all the specialties and subspecialties relevant to trauma care; relevant personnel and equipment available 24 hours a day; and most importantly, the full commitment of hospital administration to providing the best in trauma care.) Mount-Scopus campus is a 300-bed regional hospital containing the major medical specialties.

Demographical data was recorded in real time from Patients' Admission Office (PAO) figures. This information is recorded for every patient admitted to the emergency department.

The Trauma Registry (TR) documents data throughout the hospitalization of the injured victims admitted to the hospital wards. The TR serves only the Level I trauma unit at the Ein-Kerem Hospital. Both demographical sources are computerized, and the observation includes terror victims arriving to Hadassah hospitals through the period of 29 September 2000 to 28 September 2002.

Complimentary information was gained from the following:

A. The biweekly "Trauma Forum," a multidisciplinary medical meeting in which the management of individual trauma patients is discussed.
B. The monthly "Morbidity and Mortality" meetings that review the treatment of patients deceased after arrival to the hospital.
C. Medical and administrative debriefing meetings, held after each single event in which more than 10 victims had arrived to the hospital. Conclusions summarized are those that were achieved through a consensus or consolidated by the chairperson of these debriefing meetings (the first author).

Terror Epidemiology (Data Source—PAO)

During the first two years of the recent conflict, 1,916 terror victims were admitted to Hadassah, 494 of which (26%) were hospitalized in different wards. Four hundred and two of the hospitalized patients were hospitalized at Hadassah Ein-Kerem and 92 at the Mount-Scopus campus. These figures represent 33% and 13% hospitalization rates respectively. The preponderance of patients sent to Hadassah Ein-Kerem does not reflect triage based on proximity but on availability of more sophisticated resources. Death toll for patients arriving alive to the hospital was 30, most of them having succumbed within the first 12 hours. Of those injured 1,200 (63%) were male and 716 (37%) female. Eighty-six percent of the victims were younger than 44 years. (For age distribution of victims see Figure 1).

Mechanisms of Terror Injuries, Injury Severity Scores (ISS), and Body Regions Affected (Data source—TR)

Terror injuries were related to one or more of the following mechanisms: stoning, stab wounds, lynching, shooting, injury related to hand grenade, Molotov cocktail, suicide bombing, and bombing. Our TR data disclosed that 122 victims suffered blunt trauma;
130 had blast injuries; 25 experienced burns, and 348 had penetrating trauma (of which 238 were caused by gunshot wounds, 12 by stabbing, and 98 induced by shrapnel’s penetrations). It is important to emphasize that different forms of metal junk including nails, bolts, screws, and small metal knobs were associated with the bombs.

Injury Severity Score (ISS) is a 0 to 75 ordinal scale based on the square of a sum of the three most severely affected anatomical regions. ISS ≥ 16 is usually considered major trauma. ISS groups for the Hadassah terror population are shown in Figure 2. Body distribution of injuries was: 161 head and neck, 107 chest wounds, 104 abdomen, 239 upper and lower limbs, and 25 spinal injuries. It is obvious that for each single patient more than one region could be injured.
Hospital Resources That Were Utilized for the Treatment of Terror Victims (Data Source—TR)

The sum of acute hospitalization days (excluding time in rehabilitation) needed was 5,510 days (range 1–169, average 11.2, and median 6). One hundred and fifty-five of the victims needed intensive care stay for a total of 1,216 days (range 1–109, average 8, and median 3).

Analysis of the Demographic Data

Comparison of two different injury source populations in Hadassah (terror victims versus patients wounded by other forms of trauma excluding terror) (Data source—TR), demonstrated that ISS, mortality, and any other trauma severity proxy examined were statistically significantly higher ($p < 0.0001$) in terror victims (see Table 1).

Therefore, it appears that terror is associated with a more severe form of injury. In addition, the data demonstrates that terror victims place elevated demands on hospital resources compared to any other forms of trauma. Previously the authors had demonstrated a higher average cost (as paid by Israel National Insurance) for hospitalized terror victims, $3,200 compared to $2,500 for patients hospitalized due to trauma of other etiologies. These figures take into account only the per diem hospitalization tariffs (in Israel, the cost of a day in the Intensive Care Unit is equivalent to a day in any other less resource-demanding ward). These sums do not include rehabilitation and ambulatory tariffs. Figuring realistic direct and indirect expenses will naturally disclose much more pronounced differences due to the significantly different patterns of terror injuries.

The greater need for operative interventions in the terror population can be explained by higher rates of penetrating wounds in this form of intentional injury, compared with blunt trauma, which predominates over other etiologies of injury. The age and gender of the terror-injured population are similar to those described for other forms of trauma—predominantly young males. This pattern is well described for other forms of intentional and unintentional injuries. It seems that the relatively high rate of women injured by terror, compared to those described for other forms of trauma, may be explained by attacks aimed at recreational centers (discos, markets, malls, etc.). These sites are also commonly visited by youngsters. Comparison of the anatomical locations of terror injuries in this series to fatal wounds associated with bullets and shrapnel during a full-scale war as previously described by the authors, demonstrates slightly lower rates for head, neck, and torso compensated by a higher rate of limb injuries for the terror patients.

Table 1

<table>
<thead>
<tr>
<th>$P$ value</th>
<th>Nonterror</th>
<th>Terror</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;0.0001</td>
<td>14%</td>
<td>31% ISS* 16+</td>
</tr>
<tr>
<td>&lt;0.0001</td>
<td>12%</td>
<td>38% Patients in ICU**</td>
</tr>
<tr>
<td>&lt;0.0001</td>
<td>45%</td>
<td>60% Need of operations</td>
</tr>
<tr>
<td>&lt;0.0001</td>
<td>15%</td>
<td>44% Early operations</td>
</tr>
<tr>
<td>&lt;0.0001</td>
<td>2%</td>
<td>7% In-hospital mortality</td>
</tr>
</tbody>
</table>

*Injury severity score.
**Intensive care unit.
Lessons Learned That Can Be Applied to Terror
Related to Weapons of Mass Destruction

The authors believe that terror forms a new class of epidemiology, which may affect the civilized world for years to come. Therefore its special characteristics should be familiar to the medical community and to society’s decision makers.9

One of the tasks that each medical leader should acquire is the ability to manage MCI. The authors define MCI as an incident in which the medical system is overwhelmed and the balance between resources and demands is undermined. The principle aim of the overall medical management of the event is to decrease mortality, morbidity, and permanent disability in the affected population.10 This concern for the entire involved population may be on behalf of the interests of the single specific patient. This may be done, even at the cost of providing some of the victims an inferior level of treatment for the initial period.11 During a megaterror attack, accomplishing better medical outcomes may offer national leaders more flexibility in selection of the response magnitude against offenders.

Core parts of the algorithms for terror management are generic regardless of the type of offense (see Figure 3). The main issue in MCI management is administrative—involving triage (prioritization of treatment of salvageable victims), transportation of

| ✓ Confirm information |
| ✓ Gather data: Type of event, location, estimated number of casualties, severity of injuries, estimated time of patients' arrival |
| ✓ Evacuate emergency department |
| ✓ Call for extra medical and paramedical staff |
| ✓ Notify operating rooms, imaging, blood-bank |
| ✓ Stop elective operations |
| ✓ Assign a triage officer |
| ✓ Decide whether decontamination will be needed |
| ✓ Decide whether to set up extra admission areas |
| ✓ Open control station |
| ✓ Open public information center |

Figure 3. Checklist for the initial medical management of a terror attack.
mass number of victims, and optimization of resource utilization. Some medical steps are naturally unique to different terror scenarios. Indeed, the medical treatment of shrapnel-wounded patients differs from that of nerve-gas victims. Preparations can be categorized according to the time schedule related to the event.

Pre-Event

The authors feel that Western democracies should perceive themselves as potentially being in the pre-terror event phase and act accordingly. The first important stage is to define the threats. The terror arsenal may include any of the following:

1. Conventional weapon attacks together with the complex mechanisms described—blast and unique asymmetrical projectiles.
2. Chemical assault.
3. Biological attacks, using either microorganisms or toxins.
4. Radiation—"dirty bomb" (i.e., mixture of conventional detonation and radioactive materials).
5. Cyber-terror of the degree to which medical systems are vulnerable to interruption in computerized systems.

Another type of classification would categorize events as "overt," such as an explosion or, in some cases, a chemical attack, versus "silent attacks" (biological, radiation, and occasionally chemical). Another categorization would define "short-term events," such as a bus explosion, as opposed to "long-term events," such as a biological attack or an incident requiring extrication.

After defining the threats it is time to put in writing a Standard Operating Procedure (SOP). These procedures should include generic chapters describing the algorithms that are universal to all threat management procedures, followed by those that are exclusive to each different intimidation. Apart from the sections dealing with the whole institute, specific departments and units should have their own chapters in the SOP. Plans should include optimal assignment of personnel and optional locations for additional admission areas. Early preparations will include purchasing of protection gear, decontamination facilities, backup communication systems, antidotes, and so on. Revised SOPs should be distributed to managers at different levels of administration. Instruction of the hospital's medical and paramedical staff should follow. Training may take the form of lectures, introductory tours at the different sites, and self-learning using multimedia instruction aids. The final stage of preparations is the running of drills. Two classes of drills are recommended that are complimentary and nonsubstitutionary: (1) Manager's "round table" drill and (2) full-scale drill with full participation of the entire staff. In order to try and imitate realistic conditions simulated casualties are used. The mock casualties may be soldiers or even to some extent dummies. Appropriate make-up may enhance the simulation of different specific injuries. The authors' experience suggests the inclusion of "smart simulated casualties." These are physicians or paramedics who can provide crucial feedback on the performance of the staff.13,14

Post-Event

Each MCI and drill should be followed immediately by the debriefing process. Senior representatives and managers of all medical and administrative units playing a role in the event should participate. Conclusions should be drawn and lessons learned. These
should be distributed across the entire organization and to other relevant parties. SOPs should be updated immediately, because the next event could take place at any time.

Conclusion

The authors’ experience with years of preparation and coping with massive terror attacks have taught them important lessons:

1. Terror demonstrates a new type of epidemiology that is associated with a unique and oddly severe pattern of injuries, putting a heavy burden on society.
2. Alertness and early preparedness will reduce the chaos during an attack.
3. Optimal triage will maximize utilization of limited resources.
4. Proper management of terror events may decrease morbidity and mortality.

The authors believe that continuous preparation and readiness on behalf of all sectors of the medical society will enhance the strength and endurance of society against conventional and WMD terror.

Notes

1. Available at (www.idf.il/daily statistics 2002).
7. Ibid.
10. American College of Surgeons. Resources for Optimal Care of the Injured Patient (Chicago: Committee on Trauma, American College of Surgeons, 1999).