The twin terrorist attacks in Norway on July 22, 2011: The trauma center response

Christine Gaarder, MD, Joakim Jorgensen, MD, Knut Magne Kolstadbraaten, CRNA, Knut Steinar Isaksen, MD, Jorunn Skattum, MD, Rune Rimstad, MD, Trine Gundem, MD, Anders Holtan, MD, Anders Walloe, MD, Johan Pillgram-Larsen, MD, *and* **Paal Aksel Naess, MD,** *Oslo, Norway*

BACKGROUND: The terrorist attacks in Norway on July 22, 2011, consisted of a bomb explosion in central Oslo, followed by a shooting spree in a youth camp. We describe the trauma center response, identifying possible success factors and suggesting improvements for institutional major incident plans.

METHODS: The in-hospital response is analyzed. Data on triage, patient flow, injuries, treatment, resources, and outcome were collected.

RESULTS: The explosion caused a total of 98 casualties and 8 died at scene. Ten patients were triaged to the trauma center, with the first patient arriving 18 minutes after the explosion and 7 patients within the next 19 minutes. The shooting caused 68 deaths at the scene and 61 injured. The trauma center received a total of 21 patients from the shooting incident.

Surgical leadership was divided between emergency department triage with control of personnel and communication as well as control and supervision of treatment with retriage and optimal use of trauma surgical resources (dual command). Surge capacity was never exceeded in the emergency department, operating rooms, or intensive care units.

Of the 31 patients treated at the trauma center, 20 had an Injury Severity Score of more than 15 and 25 required repeated operation, for a total of 125 operations during the first 4 weeks. One patient died, for a critical mortality of 5%.

CONCLUSION: A trauma center can handle many patients with severe injury, with low critical mortality when protected from a large number of walking wounded. Limited specific trauma surgical competence was managed by the adoption of a dual surgical command model *(J Trauma Acute Care Surg.* 2012;73: 269–275. Copyright © 2012 by Lippincott Williams & Wilkins).

LEVEL OF EVIDENCE: Therapeutic/care management study, level V.

KEY WORDS: Disaster management plan; mass casualty incident; terrorist attacks.

BACKGROUND

On July 22, 2011, two sequential terrorist attacks took place in Norway. At 3:25 PM, a car bomb was detonated in the executive government quarter of Oslo. The explosion started fires, and windows were blown out in several blocks. One floor collapsed in the main government building, and the disaster area was so large that initially, the primary incident location was uncertain. Within minutes of the explosion, the professional evacuation of a large number of injured people was started.

Rumors about shooting at the political youth camp on Utoya, an island approximately 40 km northwest of Oslo, were confirmed shortly after 5:25 PM. However, reports were confusing as to the number of gunmen and victims, and the island remained almost inaccessible, owing to security issues for the duration of the rescue operation. The evacuation was challenging because the island was accessible only by boat and because victims were found dispersed throughout the island. Survivors with and without injuries had started swimming and were picked up from the water and beaches. The assassin, who was disguised as a police officer, shot 129 people before he was arrested at 6:27 PM. He had used at least two different weapons: a handgun and a rifle with expanding ammunition.

Both incidents took place in the catchment area of the regional trauma center for the southeastern health region in Norway, Oslo University Hospital Ulleval (OUH-U). OUH-U received casualties from both incidents. This report describes the trauma center response to these events with focus on triage, patient flow, and resource use. Moreover, the strategy to preserve the quality of trauma is evaluated. Several additional success factors not identified in the previous institutional exercises or described in the disaster management plan became apparent and are currently being incorporated into the plan.

Submitted: January 28, 2012; Revised: April 3, 2012; Accepted: April 9, 2012.

From the Departments of Traumatology (C.G., J.J., K.M.K., J.S., A.H., P.A.N.), Vascular Surgery (J.J.), Gastroenterological Surgery (K.S.I.), Emergency (R.R.), Anaesthesiology (T.G., A.H.), Orthopedic Surgery (A.W.), Cardiothoracic Surgery (J.P.-L.), and Pediatric Surgery (P.A.N.), Oslo University Hospital, Ulleval, Nydalen, Oslo.

Address for reprints: Christine Gaarder, MD, Department of Traumatology, Division of Emergency and Critical Care, Oslo University Hospital, Ulleval, PO Box 4950, Nydalen, N-0424 Oslo, Norway; email: tinagaar@online.no.

DOI: 10.1097/TA.0b013e31825a787f

MATERIALS AND METHODS

OUH located in central Oslo, is a large academic hospital in four locations, and OUH-U (900 beds) is the only equivalent to a Level I trauma center in Norway and currently covering a population of 2.7 million. Approximately 1,500 patients

with trauma are admitted at OUH-U per year. Consistently, 40% (500–600 patients) have an Injury Severity Score (ISS) more than 15. Blunt trauma is the mechanism of injury in 90% of the patients.[1]

Prehospital triage in the Oslo area mandates all patients with potentially severe injury to be transported to the trauma center in addition to nonsevere injuries from the hospital's primary catchment area. The patient is defined as potentially severely injured if hemodynamically compromised or has obvious severe injuries according to the American College of Surgeons field triage criteria. Fractures and other minor injuries that can be managed on an outpatient and day care-operation basis are treated in a combined casualty and primary health care facility, with a low threshold for referring patients to the trauma center. To protect the trauma center from a large number of walking wounded and make triage as simple as possible for the prehospital personnel, the disaster management plan is based on the same triage principles. OUH-U is the referral center for patients with severe injury from all acute care hospitals in the region. The regional major incident plan is activated when more than one health trust is involved and has activated their local major incident plans. The most important tool in the plan is regional coordination of resources, and when needed, a temporary redistribution of catchment areas for emergency cases, planned operation, and inpatients. The prehospital immediate response to the incidents on July 22, 2011, has recently been described.[2]

The current trauma center disaster management plan describes the following key roles. The trauma team leader is responsible for triage in the emergency department (ED). The teams are built by the consultant orthopedic surgeon on call. Anaesthetic staff is initially managed by the consultant anesthesiologist on call. Operating rooms (ORs) and staff are coordinated by the consultant cardiothoracic surgeon on call in cooperation with a senior OR nurse. The postanesthesia care unit (PACU) and intensive care units (ICUs) are initially coordinated by the consultant intensivist on call. Specific systems for mobilization of available personnel and evacuation of the ED, PACU, ICUs, and wards have recently been updated. Code red activates notification of all available personnel in a top-down sequence. Personnel will register in their own unit. Trauma team trained personnel are then referred to a designated area in the ED and assigned to a team by the team builder. The therapy in the PACU and ICU is directed by dedicated anesthesia personnel in cooperation with trauma competent surgeons.

The trauma room consists of three trauma bays equipped with monitors and ventilators, overhead x-ray gantry, standby ultrasound machine for focused assessment with sonography for trauma, and operative equipment for all relevant trauma procedures. In addition, the ED will convert three nearby rooms to resuscitation bays in case of a mass casualty incident (MCI), while an open observation area will be converted into an observation area for patients without obvious severe injuries. The ED consists of 22 beds. A helical computed tomographic scanner is located next door to the trauma bay. The primary receiving high-dependency unit is the 16-bed PACU with trauma specific competence, which can be converted into a fully equipped trauma ICU. Next door is a 13-bed surgical ICU normally admitting the patients with most severe injury. OUH-U is normally run with a total of 31 ICU beds. However, in an MCI situation, the number can be increased to 60 ICU beds with ventilator capability. Demographics and data on injuries, injury severity, and surgical procedures were collected.

In-hospital data were recorded on patient flow including arrival time, dispatch times from the ED, OR times, as well as length of stay in the PACU or ICU, and mortality.

Furthermore, data on radiology and blood product use were registered. Anatomic injury was classified according to the Abbreviated Injury Scale 1998.[3] The ISS was calculated based on Abbreviated Injury Scale.[4] Because the new ISS (NISS) has been claimed to be more predictive of outcome in penetrating injuries, NISS was also calculated. Critical mortality is defined as the number of deaths for patients with ISS of greater than 15.[5] The study was approved by the Ombudsman for Patient Privacy.

RESULTS

After the car bomb had exploded at 3:25 PM in front of the executive government quarters, the site was declared a major incident by a medical commander at 3:33 PM. A total of eight people were declared dead at the scene.

Two local triage units were established adjacent to the explosion site and managed initially by paramedics and anesthetists who followed regular criteria for triage to the trauma center, and 10 of 98 registered casualties were transported to OUH-U.[2] One of these patients is excluded owing to lack of written consent. The other 88 were categorized as walking wounded and brought to the nearby public walk-in clinic. One of these patients was transferred to a local hospital for more extensive debridement but was not severely injured.

A total of 68 victims were declared dead at the youth camp on Utoya. Of the 61 registered injured, 12 were transported directly to the trauma center (OUH-U), arriving between 1.5 hours and 3.5 hours after the gunman had been arrested at 6:33 PM. Another nine patients followed as secondary transfers from three local hospitals. Some of these had been triaged to the trauma center at the scene, but owing to some confusion regarding the location of the casualty clearing station and evacuation points, they were brought by ground ambulance to the closest hospital, for secondary transfer to the trauma center.[2] This apparent undertriage to the trauma center was thus caused by logistics. All secondary transfers were deemed in need of more surgical and critical care experience than could be provided at the local hospital.

These two terrorist attacks generated more than 220 casualties, and 77 people died, 76 of whom died at the scene.

Immediate ED Response and Organization

At 3:41 PM, the major incident plan was activated at all four academic hospitals constituting Oslo University Hospital Trust, with OUH-U as the only receiving facility for patients with severe injury. The first patient arrived at 3:51 PM, and 7 patients had arrived within the next 19 minutes (Fig. 1). Triage and control of personnel flow and communication in the ED was performed by an experienced consultant trauma surgeon. A second consultant trauma surgeon supervised the management

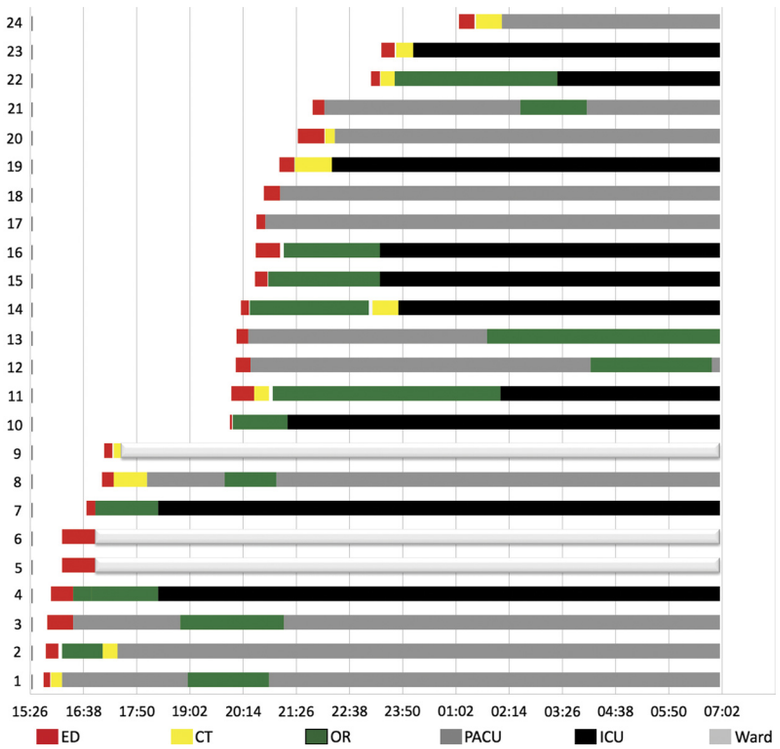

Figure 1. Patient flow during the first 15 hours. Lower part (patients 1–9) from bomb explosion and upper part (patients 10–24) from the shooting incident. CT, computed tomography.

of the trauma teams in the ED and in the OR. In addition, the role of the second consultant consisted of directing the trauma-specific surgical competence to where most needed, whether in the more complex operative procedures or in previously not described key roles such as performing retriage and taking part in the clinical work and planning in the PACU and ICU. A third consultant with trauma experience administered the OR resources. Seven of the patients from the bomb explosion were assigned trauma teams, and patient flow and resource use is illustrated in the lower part of Figure 1. In general, a damage control approach was applied including rapid assessment and minimal use of radiology in the ED.

Evacuation

The ED was evacuated within 15 minutes. In accordance with the major incident plan, the PACU was evacuated before the ICU. Within 15 minutes, 10 beds were available. The surgical ICU then started transfer of patients to other ICUs within the Oslo University Hospital Trust. Within 45 minutes, OUH-U had 19 staffed ICU beds available, of which 15 had ventilator capabilities. The PACU received four of the patients from the bomb explosion within 1 hour of the first incident. Although patient flow seemed to slow down from the bomb explosion, there was still a lack of information from the scene about the number of expected casualties. A gradual reduction in staffing was being planned when the rumors started to emerge about the shootings at Utoya. The mass murder incident was confirmed and had lasted for approximately 1 hour when the assassin was arrested at 6:33 PM.

OUH-U received the first patient from the shooting at 8:57 PM, with a total of 15 patients arriving before midnight (Fig. 1, upper part). Three of these were transferred from other hospitals. As illustrated in Figure 1, the ED capacity was never exceeded, with a maximum surge of nine patients per hour. The actual patient surge and available personnel allowed teams to be assigned when severe injury could not be ruled out by ED triage.

Operating Rooms

A total of 16 patients were operated on the first 15 hours after the explosion. Two ORs were busy upon arrival of the first patients. Later, a maximum of six ORs was running concurrently (Fig. 1). The OR capacity was thus never exceeded because 12 OR nursing teams and 16 ORs were available. The damage control approach was applied until after midnight, owing to lack of definitive information from the scene. Three patients were scheduled for operation before the incidents. Two were postponed until the next day, and one was operated on later in the night. Table 1 shows the procedures performed until the next morning.

Critical Care Units

Of the 25 patients admitted that evening, 12 patients were admitted to PACU and 10 to ICU. Of these, 12 were still on ventilator the next morning. The evacuation and patient surge to PACU and the surgical ICU are illustrated in Figure 2. The maximum number of ventilated beds possible to staff at any given time is 60.

TABLE 1. Procedures Performed During the First 15 Hours

	Procedures	n
Head/neck	Craniotomy	3
	ICP monitor	3
	Debridement	5
	Tracheostomy	2
Face	Debridement	8
Chest	Chest tubes	7
	Thoracotomy	1
	Debridement	5
Abdomen	Therapeutic Laparotomy	4
	Non-therapeutic laparotomy	4
	Debridement	5
Upper extremity	Debridement	8
	Amputations	1
Lower extremity	Ex fix	2
	Debridement	6

ICP, intracranial pressure.

Transfusions

Massive bleeding protocol was activated in seven patients. A total of 53 U of packed red blood cells, 39 U of pooled plasma (Octaplas, Lachen, Switzerland), and 14 U of pooled platelets (each from 4 donors) were administered during the first 24 hours.

The trauma center received a total of 31 patients. The last six patients arrived as secondary transfers the following day (n = 5) or after 2 days (n = 1). Patient and hospitalization characteristics are summarized in Table 2. Of the 20 patients who had an ISS of greater than 15, one died in hospital, for a critical mortality rate of 5%. The patient was diagnosed on arrival with a nonsurvivable head injury. Of the 30 patients, 25 required repeated operation. This generated a total of 125 sessions in the OR (range, 1–13) during the first 4 weeks, for a total of 431 hours of OR time (Table 2). The patients from the youth camp had been hit by a total of 44 bullets (range, 1–4 per patient), and 33 of these were classified as expanding ammunition (Fig. 3). Table 3 shows the injuries sustained by the patients triaged to the trauma center.

DISCUSSION

These two attacks represent a unique combination of a bomb explosion and a shooting spree, the two major forms of modern terrorist activity both generating complex and severe injury patterns.[6] The nature and combination of these incidents challenge some of the commonly perceived opinions about MCIs, thus adding to the body of knowledge about modern terrorism.

As in most institutions worldwide, the surgical trauma competence in OUH-U is a limited resource. Based on this and the fact that the entire treatment chain cannot be supervised from the ED entrance, Hirshberg et al.[7] in 2002 described the dual command concept as a universal principle to conserve resources and provide optimal care to the patients during an MCI. In accordance with this concept, a consultant trauma surgeon was in charge of the triage at the ED entrance, control of personnel flow in the ED, and communication with the incident scenes. A second consultant trauma surgeon supervised the treatment in the ED and OR.

Several positions vulnerable to errors of in-hospital judgment and treatment were identified needing dynamic upgrading with a trauma experienced staff. Persons assigned to these key positions reported to the two lead trauma consultants. The surgical lead roles are currently being described, and the dual-command concept will be implemented in the revised institutional disaster management plan, as well as the other identified key roles and better definitions of the existing ones.

The ideal goal during an MCI is to maintain sufficient capacity at all treatment locations,[7,8] achieved in our situation by maximum mobilization of personnel. Minimal time in ED was achieved by dynamic use of teams, including deliberate "overtriage" based on available information from the scene about the likely number of patients still to arrive, and the number of teams available. At no time point were all the beds for critical injuries occupied.

It is often difficult to determine whether the patient is sick or "will be sick soon" during the initial triage.[7–9] Assigning trauma teams to some of the patients with less severe injury protected against undertriage. In addition, not all of the surgeons routinely manage patients with trauma. The use of the dual-command concept made supervision of the teams possible and allowed redirection of the core trauma experienced personnel. The importance of trauma trained staff in core control positions for retriage and optimization of resources after MCIs have been underlined in previous reports.[8,10]

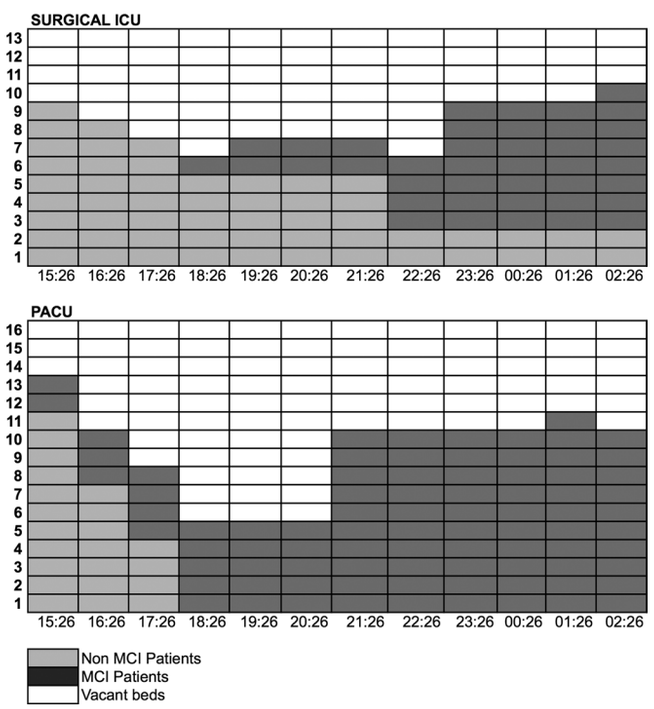

Figure 2. Evacuation and patient surge to PACU and the surgical ICU.

TABLE 2. Patient Demographics and Outcomes

	Explosion (n = 9)	Shooting (n = 21)	Total (n = 30)
Age, mean (range), y	37 (19–67)	18 (14–3)	24 (14–67)
Female, n	4	14	18
ISS, mean	26	21	23
ISS, median)	24	20	20
ISS > 15, n	5	14	19
NISS, mean	28	30	30
LOS total, d	142	342	484
LOS ICU, d	93	181	274
Ventilator days	53	75	128
Deaths, n	0	1	1
OR sessions, n*	33	92	125
OR hours*	115	316	431

*Numbers given as totals for the first 4 weeks.
LOS, length of stay.

As part of minimal acceptable care, the use of radiology in the ED was restricted to diagnosing potentially life-threatening conditions. Focused assessment with sonography for trauma was used as a screening tool for abdominal bleeding, mandating laparotomy when positive. This resulted in four of eight laparotomy findings being negative. This is consistent with the experience of others.[11,12]

TABLE 3. Injuries Sustained by Admitted Patients From the Two Incidents

Body Region	Injuries	Explosion (n = 9)	Shooting (n = 21)
Head/neck	Intracranial bleeding	4	4
	Soft tissue injuries	4	9
	Fractures	4	4
	Contusions	3	3
Face	Fractures	4	6
	Eye injury	2	2
	Tympanic injury	2	
	Soft tissue injury	5	5
Chest	Hemothorax	1	4
	Pneumothorax	2	5
	Mediastinal injury		2
	Rib fractures	2	3
	Lung contusions	5	7
	Soft tissue injury	4	7
	Other fractures	2	2
	Diaphragm		2
Abdomen	Stomach		2
	Mesentery	1	1
	Small bowel	1	2
	Colon		4
	Kidney		2
	Liver	2	1
	Spleen		1
	Pancreas	2	2
	Soft tissue injury	2	8
Upper extremity	Fractures	1	7
	Nerve injury	2	4
	Soft tissue injury	6	11
Lower extremity	Fractures	4	
	Nerve injury	1	
	Soft tissue injury	5	8

Figure 3. X-ray of expanding ammunition.

Computed tomographic scan in the ED was restricted to patients with suspected severe head injuries. However, radiologic capacity elsewhere in the hospital for further diagnostics after transfer to PACU or ICU was increased and was never exceeded.

OR resource use was minimized by applying damage control surgical principles or delaying operation when possible. An institution-wide damage control approach was maintained until it could be ascertained that patient flow would not be as extensive as feared and that available resources allowed more definitive treatment. The transition to a more definitive treatment approach may have been somewhat delayed owing to scarcity of information. With only six ORs occupied at any given time, the capacity was never exceeded.

By placing core trauma surgical and anesthesiology personnel to retriage and treat the patients in PACU and ICUs, the time the teams spend with each patient can be minimized and results in more effective use of limited resources.

Although many patients with severe injury were treated, the use of blood products during the first 24 hours did not represent a major challenge to the blood bank. This is in accordance with the experiences reported after major terrorist attacks during the last decades.[8,10,11]

Critical mortality has been described as the most relevant outcome parameter after MCIs, and the reported critical mortality

rates after terrorist-induced MCIs are typically between 15% and 37%.[8,10,11,13] In these two attacks, one patient died of nonsurvivable head injury from a gunshot wound resulting in a 5% critical mortality. Several factors might have influenced this low rate. The bomb explosion took place close to the trauma center and thus left little time before the arrival of the first patients with critical injury. In accordance with experience from other similar incidents, this first attack could have generated many patients with minor injuries to the trauma center. Frykberg[14] showed a direct correlation between critical mortality and overtriage to hospital. Efficient triage and predefined plans for evacuation of the walking wounded to the public medical walk-in clinic normally treating minor injuries in Oslo protected the trauma center from all but the patients with potentially severe injury, with seven of the admitted patients requiring operation.

In addition, one can argue that time to admission due to security issues, challenging evacuation and transportation time from the shooting incident to the trauma center, resulted in a selected group of patients having higher chances of survival. Delays in evacuation due to security issues, difficulty in access, and patient extrication are described from many terrorist attack scenes[8,14] to delay hospital admission and to increase death rates. The high mean ISS and NISS for the patients from these two incidents underline the severity of their injuries. Moreover, very few MCIs during the last decade have generated such a large number of patients with severe injury admitted to a single trauma center.[8,10,11,13,15] Degree of overtriage and undertriage to the trauma center is often a topic in the evaluation of a disaster response. Using severe injury (ISS, >15) as the threshold for triage to the trauma center, 5 of 9 patients from the bomb explosion and 5 of 21 from the shooting were overtriaged. However, in matching patients with institutional expertise applying the usual triage criteria to the trauma center, only the three patients from the bomb explosion discharged the following day can be seen as overtriaged, and all the patients admitted after the shooting required the trauma center experience and resources. The nine patients, who were transported to hospitals closer to the scene, for secondary transfer to the trauma center, might be categorized as undertriaged. Some of these patients had been triaged primarily to the trauma center but were taken to the closest hospital owing to logistic problems.

The weapons used were a Ruger Mini 14 semiautomatic rifle, caliber 5.56 mm, with soft-tip short stop ammunition, and a Glock 9-mm handgun, with full metal jacket ammunition. The soft-tip projectile disintegrates just as it penetrates the skin and causes extensive tissue damage with fragmentation into numerous small lead particles. The brass bottom of the ammunition moves deeper but, as opposed to fully mantled rifle ammunition, does usually not go through a leg or through the body. Even tangential wounds have cavities due to the easy deformation of the projectile (Fig. 3).

The reported patient population challenged the hospital during several weeks with extensive use of operative and ICU resources (Table 2). The most complex injuries required long-time involvement of several surgical specialties and underwent multiple surgical procedures. Continuity and coordination of treatment was provided by core trauma personnel, supported by one dedicated specialist of infectious medicine and a specialist pain-management team, as well as extensive support from all nonsurgical support functions. Multidisciplinary meetings and ward rounds to all the MCI victims were deemed necessary twice daily during the first 2 days, then on a daily basis, in accordance with the institutional daily trauma routines.

To optimize treatment, the distribution of nontrauma surgical emergencies to other hospitals was maintained during the following 2 weeks, under continuous monitoring to make sure that this could be done without unacceptable increase in workload for those hospitals. Equally, medical emergencies were redistributed to other hospitals when needed owing to the ICU situation. This allowed surgical procedures to be performed at daytime in a planned fashion and by the same surgeons, further improving continuity and quality of care for the MCI victims.

Emotional shock is a common reaction to terrorist attacks and can result in long-lasting disability and should therefore be considered in the category of injuries in need of treatment.[14] In OUH-U, psychosocial assistance was offered to all patients and their families on a systematic basis, efficiently reducing the workload of the personnel involved in the treatment of the somatic injuries. Involved personnel were equally offered psychosocial assistance with necessary follow-up.

The trauma center received immediate extensive attention from both national and international media. Our experience is that information should be provided by few people directly responsible for patient care. The importance of a formal strategy for media handling including involvement of trauma core personnel to protect the victims, relatives, and staff under such circumstances should not be underestimated.

CONCLUSION

A single trauma center can handle a large number of patients with severe injury with low total and critical mortality when protected from a large number of walking wounded. Although specific trauma surgical competence was a limited resource, effective treatment was achieved by the adoption of a dual surgical command model, dynamic use of trauma personnel in identified key roles, and damage control principles. Continuity of care and distribution of nontrauma emergencies to other hospitals during the first weeks made optimal treatment achievable.

AUTHORSHIP

Data collection was performed by C.G., J.J., K.M.K., and P.A.N. All authors contributed to the data analysis and writing process.

DISCLOSURE

The authors declare no conflicts of interest.

REFERENCES

1. Groven S, Eken T, Skaga NO, Roise O, Naess PA, Gaarder C. Long-lasting performance improvement after formalization of a dedicated trauma service. *J Trauma*. 2011;70:569–574.
2. Sollid SJ, Rimstad R, Rehn M, Nakstad AR, Tomlinson AE, Strand T, Heimdal HJ, Nilsen JE, Sandberg M. Oslo government district bombing and Utoya island shooting July 22, 2011: the immediate prehospital emergency medical service response. *Scand J Trauma Resusc Emerg Med*. 2012;20:3.

3. AIS. *The Abbreviated Injury Scale 1990 Revision-Update 98*. Des Plains, IL: Association for the Advancement of Automotive Medicine; 1998.
4. Baker SP, O'Neill B, Haddon W, Long WB. The Injury Severity Score. A method for describing patients with multiple injuries and evaluating emergency care. *J Trauma*. 1974;14:187–196.
5. Frykberg ER, Tepas JJ. Terrorist bombings: lessons learned from Belfast to Beirut. *Ann Surg*. 1988;208:569–576.
6. Peleg K, Ahoronson-Daniel L, Stein M, Michaelson M, Kluger Y, Simon D, Israeli Trauma Group (ITG), Noji EK. Gunshot and explosion injuries: characteristics, outcomes and implications for care of terror-related injuries in Israel. *Ann Surg*. 2004;239:311–318.
7. Hirshberg A, Holcomb JB, Mattox KL. Hospital trauma care in multiple-casualty incidents: a critical view. *Ann Emerg Med*. 2001;37:647–652.
8. Aylwin CJ, König TC, Brennan NW, et al. Reduction in critical mortality in urban mass casualty incidents: analysis of triage, surge, and resource use after the London bombings on July 7, 2005. *Lancet*. 2006;368: 2219–2225.
9. Einav S, Aharonson-Daniel L, Wiessman C, Freund HR, Peleg K, and the Israel Trauma Group. In-hospital resource utilization during multiple casualty incidents. *Ann Surg*. 2006;243:533–540.
10. Cushman JG, Pachter HL, Beaton HL. Two New York City Hospitals' surgical response to the September 11, 2001, terrorist attack in New York City. *J Trauma*. 2003;54:147–155.
11. de Ceballos JP, Turegano-Fuentes F, Pérez-Diaz D, Sanz-Sánchez M, Martin-Lloorente C, Guerrero-Sanz J. 11 March, 2004: the terrorist bomb explosions in Madrid, Spain—an analysis of the logistics, injuries sustained and clinical management of casualties treated at the closest hospital. *Crit Care*. 2005;9:104–111.
12. Biancolini CA, Del Bosco CG, Jorge MA. Argentine Jewish community institution bomb explosion. *J Trauma*. 1999;47:728–732.
13. Kaplowitz L, Reece M, Hershey JH, Gilbert CM, Subbarao I. Regional health system response to the Virginia Tech mass casualty incident. *Disaster Med Public Health Prep*. 2007;1:S1–S9.
14. Frykberg ER. Medical management of disasters and mass casualties from terrorist bombings: how can we cope? *J Trauma*. 2002;53:201–212.
15. Raiter Y, Farfel A, Lehavi O, Goren OB, Shamiss A, Priel Z, Koren I, Davidson B, Schwartz D, Goldberg A, et al. Mass casualty incident management, triage, injury distribution of casualties and rate of arrival of casualties at the hospitals: lessons from a suicide bomber attack in downtown Tel Aviv. *Emerg Med J*. 2008;25:225–229.

