Role of Air-Medical Evacuation in Mass-Casualty Incidents—A Train Collision Experience

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Abbreviations:
ALS = advanced life support
AME = air-medical evacuation
BLS = basic life support
CPR = cardiopulmonary resuscitation
ISS = injury severity score
IAF = Israeli Air Force
IDF = Israeli Defense Forces
MCI = mass-casualty incident
SAR = search and rescue

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Abstract

Background: On 21 June 2005, a passenger train collided with a truck near Revadim, Israel. The collision resulted in a multiple-scene mass-casualty incident in an area characterized by difficult access and a relatively long distance from trauma centers. A major disaster response was initiated by civilian and military medical forces including the Israeli Air Force (IAF) Search and Rescue teams. The air-medical evacuation from the accident site to the trauma centers, the activities of the airborne medical teams, and the lessons learned from this event are described in this report.

Methods: A retrospective analysis of data gathered from relevant elements that participated in management, treatment, and evacuation from the accident site was conducted.

Results: The accident resulted in 289 injured passengers and seven of the injured were killed. Six helicopters (performing nine sorties) participated. Helicopters evacuated trauma victims and aided in transporting air-medical teams to the site of the collision. Overall, 35 trauma victims (10 urgent) were evacuated by air to trauma centers. The length of time between the first helicopter landing and completion of the air evacuation was 83 minutes. The air-medical evacuation operation was controlled by the commander of the IAF Search and Rescue. Different crew compositions were set in real time.

Conclusions: Air-medical evacuation during this unique event enabled prompt transportation of casualties from the scene to trauma centers and provided reasonable distribution of patients between various centers in the region. This operation highlighted the necessity for flexibility in medical decision-making and the need for non-conventional solutions regarding crew compositions during management of an airborne evacuation in similar settings. Air-medical evacuation should be considered as a part of responses to mass-casualty incidents, especially when the site is remote or characterized by accessibility difficulties.

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Background

The role of air-medical evacuation (AME) services in non-disaster or military settings has been reviewed extensively. Controversy exists concerning the value of the use of air-medical versus ground transportation in any setting. The advantages of AME include rapid transportation to a receiving facility and better access for rural and wilderness rescue. Air-medical evacuation responses may be valuable when the speed of transport, skill of the medical team, and/or ability of the helicopter to overcome environmental obstacles is likely to contribute to improved patient outcomes.[1] On the other hand, AME is an expensive and relatively dangerous transport modality that necessitates multiple patient transfers from an ambulance to the helicopter and *vice versa*.[2]

The efficacy for the use of air-medical transportation is debated in large urban setting, where its advantages not always are apparent.[3–6] In contrast, a

number of studies have indicated a reduction of 21–52% in predicted mortality[7,8] and 12–40% improved survival among air transported compared with ground-transported patients.[9–11] These findings mainly were attributed to air crew medical skills and a higher rate of interventions. Aeromedical evacuation from rural areas has been studied separately in a small number of studies.[12,13] For example, in a two-year study from Norway involving 370 patients, only 11.1% of transfers were determined to have benefited from AME mainly due to a reduction in transport time from remote areas.[12]

Most of the literature during the past 20 years includes anecdotal reports of flight teams responding to a single mass-casualty incident.[14–17] Common characteristics included rapid evacuation from the scene by air and efficient distribution of patients by helicopters to various trauma centers. However, problems did occur, especially with the incident command structure, communications, casualty identification, and documentation. Thus, further studies are necessary in order to establish policy and recommendations regarding these issues.

On 21 June, 2005, a passenger train collided with a truck near Revadim, Israel, a relatively isolated area with limited ground access. The consequences were devastating: 289 passengers were injured, of which seven were killed. A major disaster response was initiated by civilian emergency medical services, Home Front Response Forces, and the Israeli Air Force (IAF) Search and Rescue (SAR) Unit.

This report describes the AME process during the event and examines the issues of command, communication, crew composition, patient distribution, triage, and admission in the context of a large-scale, train-truck collision.

Methods

In this retrospective, descriptive study, researchers reviewed the air-evacuation process following the crash. Information was gathered from various sources. Data concerning ground incident command structure and medical resources were acquired from civilian, ground emergency medical services, and the Home Front Surgeon General Headquarters. Data concerning schedules, air-medical command structure, communication, crew composition, and medical procedures were acquired from the IAF-SAR Unit; and the medical performance of air-medical teams was evaluated by the SAR Unit Medical Quality Committee. Data regarding the characteristics, nature of injuries, and hospital admissions of the casualties were acquired from the Israeli Defense Forces' (IDF) Trauma Branch and the trauma coordinators of the medical centers. Researchers participated in all of the debriefings and interviewed these key personnel who participated in the event. Data recorded included oral and written information on transported casualties, advanced life support (ALS) procedures, landing zone difficulties, crew composition, incident command structure, and emergency communication issues.

The emergency department records of 14/35 patients were reviewed. Records of the remaining air transported patients were unavailable because the patients either were admitted directly without emergency department evaluation or were not registered properly when admitted.

Results

The Revadim train crash resulted in 289 casualties, with 19 defined as "unstable". Most of the casualties were evacuated by ground teams. Seventy-nine ambulances (military and civil from the Israeli MDA public company) participated in the ground evacuation. These ambulances were staffed by 12 physicians, 35 paramedics, and 120 medics transported patients to 10 medical centers. Due to accessibility difficulties, vehicles could not spread efficiently around the various scenes and were forced to wait in a queue approximately 100–500 meters from the main scene.

General AME description

The AME was performed with six helicopters (3 UH-60, 3 CH-53) that transported patients from the scene to medical centers and brought medical teams and supplies to the scene. Helicopters carried five air-medical crews including four physicians, three paramedics, and 36 medics and executed nine sorties. All crews disembarked in order to assess and carry casualties. One physician and 15 medics were left at the scene during the AME process to assist ground forces. The AME teams made contact with 50 patients, of which, 35 then were air transported. There were 10 transports determined to be of an urgent nature (Table 1). One patient was pronounced dead during flight.

The air-medical evacuation process lasted 83 minutes (first landing to last admission). A total of 109 minutes had passed from first notification to last admission (Table 2). The average length of stay from landing to takeoff was 14.5 minutes. The average flight time from the scene to the medical center was 11 minutes. Casualties were evacuated by air to four Level-1 Trauma Centers.

Ground and In-Flight Treatment

At some scenes, flight teams were the primary responders. Of the 50 patients contacted by the air-medical teams, seven urgent patients were evacuated by ground units because their injuries were less severe and were not prioritized for AME. In several instances, air-medical personnel assisted ground units with triage and treatment. Air-medical personnel provided advanced life support (ALS) procedures (intubations) before takeoff to two patients—one was pronounced dead during flight. No in-flight ALS interventions were performed.

Triage and Admission

Air-medical teams were assigned to triage side-by-side with the ground medical teams. There was no use of triage severity tags or garments by flight personnel. The written registry by the teams was incomplete due to the need for prompt evacuations. Each sortie of evacuation was terminated inside the emergency department according to the written MCI procedures of the Ministry of Health (required in order to perform an organized medical transfer and equipment exchange).

AME Crew Composition

Helicopter AME crew composition in the IAF-SAR Unit includes a physician, a paramedic or a medic, and 3–6 SAR medics. This configuration had to be changed during the

Patient #	Nature of injury	Receiving Medical Center	ED ISS	ICU admission
1	Infant Head trauma	A	NA	No
2	Pelvic injury	A	22	Yes
3	Head trauma—Intubated	A	17	Yes
4	Abdominal injury	A	22	Yes
5	Head trauma—Dead on arrival	B	--	---
6	Dyspnea	B	NA	No
7	Amputation	B	NA	Yes
8	Child—Abdominal injury	B	20	Yes
9	Abdominal injury	A	22	Yes
10	Head trauma	C	16	Yes

Table 1—Urgent accident victims evacuated by air-medical teams. Listing according to order of evacuations. (ED = emergency department; ICU = intensive care unit; ISS = injury severity score; NA = not available)

Time	No. of Casualties Evacuated	Distribution Medical Center	Event	Type of Aircraft	Number of Helicopters Used
17:46	n/a	n/a	First call to ground emergency medical center	n/a	n/a
17:54	n/a	n/a	IAF control center is notified	n/a	n/a
17:55	n/a	n/a	A warning is transferred to IAF squadrons	n/a	n/a
18:02	n/a	n/a	A call for 3 squadrons on duty	n/a	n/a
18:12	n/a	n/a	First landings	UH-60	n/a
18:15	n/a	n/a	Second landings	UH-60, CH-53	n/a
18:15–18:45	n/a	n/a	3 additional helicopters are called	UH-60, CH-53	n/a
18:24	2	Medical Center A	Evacuations	UH-60	1
18:30	2	Medical Center A	Evacuations	UH-60	2
18:45	8	Medical Center B	Evacuations	CH-53	1
18:50	2	Medical Center B	Evacuations	UH-60	3
19:02	1	Medical Center A	Evacuations	UH-60	1
19:05	4	Medical Center C	Evacuations	CH-53	2
19:07	2	Medical Center D	Evacuations	UH-60	2
19:20	11	Medical Center C	Evacuations	CH-53	3
19:25	3	Medical Center A	Evacuations	UH-60	3
19:35	n/a	n/a	Last Admission from air evacuation	n/a	n/a

Table 2—Rolling schedule (IAF = Israeli Air Force, n/a = not applicable)

event due to the mass-casualty setting with a high casualty/medical crew ratio. Thus, the Incident Air Support Manager was compelled to proceed with the air evacuation using various crews' compositions as specified in Table 3.

All of the SAR Unit medical crews were certified as airborne personnel according to the SAR Unit procedures. Two evacuations were performed with the assistance of ground medical forces personnel who were assigned to existing crews due to the relative lack of certified airborne medical personnel. Three evacuations were staffed by paramedics as the senior team member.

Command Structure

The key personnel who were responsible for managing the AME were the IAF-SAR Unit Commander and the first physician on the scene (a trauma specialist) who were transported to the incident site by the first helicopters. They assigned medical crews to patients who were candidates for air evacuation and established the priority of loading according to the helicopters present. In addition, they tried to contact helicopter crews before landing in order to direct the pilots to the appropriate landing zones and inform the medical teams on the patients ready for evacuation. Specific

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Evacuation Number	Patients Transported	Severely Injured Patients	Crew Composition		
			Physician	Paramedic	SAR Medics
1	2	2	0	1	2
2	2	2	0	1	3
3	8	3	1	1	2
4	2	1	1	1	1
5	1	1	0	1	2
6	4	1	1	0	2
7	2	0	1	0	2
8	11	0	1	0	6
9	3	0	1	0	2
Total	35	10	6	5	22

Table 3—Air-medical evacuations by crew compositions (SAR = search and rescue)

landing zones were not defined nor assigned by helipad managers, which resulted in at least two helicopters not landing in the most appropriate site for efficient loading.

Communication

Information concerning the site of the collision and the specific mission was given through direct communication between the IAF Control Center and the helicopter pilots. Distribution priorities and evacuation destination of each sortie were determined by the Home Front Surgeon General Control Center and transferred to the helicopter pilots through the IAF Control Center. Hospitals were notified by the Home Front Surgeon General Control Center through direct communication.

Communication between the SAR unit commander on the scene and the incoming pilots and medical teams was established only 20 minutes after the first helicopter landing. As a consequence, information regarding landing zone characteristics and severity of injuries were not transferred in real-time to the helicopter crews at the onset of the event.

Discussion

This MCI has demonstrated the efficacy of a relatively large-scale air-medical evacuation from a remote crash zone, characterized by multiple scenes, limited ground access, and prompt transportation of urgent patients. Important advantages of AME, such as prompt evacuation of urgent casualties from the scene by air and efficient distribution of patients to Level-1 Trauma Centers also were demonstrated.[14–17]

The engagement of air-medical teams was rapid. The first three helicopters landed 18–21 minutes after notification to the IAF Control Center and 26–29 minutes after first notification to the Ground Emergency Services Control Center. Three other helicopters, which were not on duty, landed with available air and medical crews within another 30 minutes. Recruitment of air and medical forces was enabled due to an early recognition by the IAF Control Center Commander that a MCI was evolving and that accessibility difficulties were making the use of air-medical evacuation of crucial importance. As was discussed by Barbash *et al*, AME in this event also was used as a "feeding channel" of medical reinforcement to the poorly staffed scene while en route to the incident site.

Air-medical evacuation played an important role in the event as reflected from the severity of injuries of the patients transported. Of 19 casualties defined as urgent or severely wounded, 10 (53%) were evacuated by air. Severely injured patients were transported by air to four Level-1 Trauma Centers that are located relatively far (40-80 km) from the scene. Without AME, most of these urgent patients would have been admitted to nearby peripheral facilities, overwhelming their emergency departments. Efficient distribution of patients, as was demonstrated in the current event and during other MCIs, decreases the burden in adjacent medical centers and directs patients with specific injuries to appropriate facilities.[15,16]

Few ALS procedures were performed (two intubations) by AME teams and no ALS procedures were performed during flight. There are conflicting data regarding the benefits of ALS procedures conducted on-scene during ground transport. Jacobs *et al* noted that ALS procedures had no effect on evacuation times, but improved trauma scores and proved to be a positive indicator for survival.[19] In contrast, most studies showed that in urban settings, there is no benefit in having on-site ALS for prehospital management of trauma patients.[20–22] Additionally, there is a general agreement among trauma specialists that it is unusual for any dramatic medical life-saving interventions to be performed at the scene, particularly when experienced medical teams are present and the distance to appropriate medical care facilities is <15 minutes.[23]

AME Crew Compositions

The characteristics of the event (mass casualties and relative lack of medical crews) caused the AME manager to decide on splitting crews and assigning paramedics as senior personnel in some of the evacuations. No specific problems were documented during these evacuations, as reflected by the patients' outcomes and evaluated by the SAR Unit Medical Quality Committee. This was the first event in Israel in which AME was performed by paramedics acting as the senior air-medical team member rather than a physician, contrasting the commonly used crew configuration.

Many studies discussed possible differences in outcomes regarding air-medical crew composition. Most studies show no significant difference in clinical outcomes.[24–28] Three studies demonstrated an outcome benefit when a physician acted as the senior personnel as is explained by the greater amount of ALS procedures performed by physicians.[29–31] However, a lack of standardization in paramedics' qualifications and experience may have biased the results in these studies.

Two evacuations were performed with the assistance of ground medical forces personnel who were assigned to existing crews. Participation of ground medical personnel in AME helped overcome the relative lack of airborne medical crews. On the other hand, placing unqualified personnel who do not meet the specific requirements of an air-medical crew member can interfere with in-flight teamwork, and eventually, harm the performance of the whole crew. Nevertheless, in a situation in which there is a lack of air-medical teams, the Air Manager should consider creating new crews with the assistance of ground medical personnel even though they might not meet specific qualifications. Joint training sessions should be conducted with ground personnel receiving training in aircraft safety, teamwork within the air-medical crew, and medical performance inside the cabin.

Incident Command Structure and Communication

The whole AME operation was controlled and managed by the IAF Control Center according to formal procedures and consistent with principles of central control. Command and control (IAF Control Center, Home Front Control Center, IAF-SAR operation room, Ambulance Service Control Center) is used to provide an improved and updated picture that enables prompt, real-time decision-making regarding the number of helicopters and air-medical crews, landing zones, and destination of each evacuation. It also ensures flow of updated information between control centers and timed notification to receiving facilities.[18] Failures in control algorithms were not identified during this event.

The Air Support Manager (IAF-SAR Unit Commander) flew on one of the first helicopters assigned medical crews to the scene of the crash and determined priorities for air evacuations. He also controlled the landing and loading order of the helicopters, and decided on crews to be assigned to specific helicopters. The assignment of an Air Support Manager during a MCI is directed by the IAF Control Center and is a formal responsibility of the IAF Cooperation Unit that can send a team to the scene within several hours. This event emphasized the necessity for placing an Air Support Manager at the scene as soon as possible. This only can be achieved by using senior personnel from the IAF-SAR Unit who can fly into the scene together with one of the first air-medical teams.

The Air Support Manager's decision to compose, in real-time, teams of paramedics as senior personnel was reasonable and enabled physicians to be cleared for triage and provided assistance to ground medical forces. In addition, the relative lack of qualified air-medical crews urged him to assign ground medical force personnel to aerial evacuations in order to reinforce partially staffed crews. This flexibility in medical decision-making is required from an Air Support Manager present at the scene.

Geographical division of the scene, definitions of specific landing zones, and assigning a commander to each scene would have helped control helicopter landings according to casualty concentration zones. The fact that initially, there was no common radio frequency for helicopters and air-medical teams created difficulty in engaging the incoming medical crews, notifying them about candidates for evacuation, and in directing pilots to optimal landing zones. The need for immediate communication between the Air Support Managers and air crews should be addressed as early as possible and prioritized accordingly. This issue should be a part of the qualification process of an Air Support Manager.[18]

This study demonstrates the need to integrate an Air Support Manager into the ground incident command as soon as possible. A planned approach for the qualification of Air Support Managers and the assignment of helicopters during mass-casualty incidents can improve the process of evacuation, maximize the benefit of air-medical crews, and prevent redundant or inadequate response at the scene.

Triage, Registration, and Admission

The issue of patient registration and marking often poses a problem during a MCI.[15] During this event, there was a lack of standardization in registration methods between emergency ground medical forces and the IAF-SAR medical crews. An effort should to standardize marking resources, preferably, the use of color-based garments. Lack of proper registration can hinder the evacuation priority setting and result in a loss of essential information regarding transported patients.

Each evacuation sortie was terminated inside of the emergency department. This lengthened the sorties and caused further delay in transporting teams back to the accident site. This well-known and practiced procedure is not always appropriate during a mass-evacuation operation. A shortened procedure should be adopted for similar settings in order to improve AME process. It is reasonable that, during a MCI, casualties will be transferred to hospital crews adjacent to the helipad instead of within the emergency department. This procedure will enable air-medical crews to be available to continue airborne evacuations.

Conclusions

The effective use of air-medical services during MCIs requires planning, coordination, and training. Air and ground personnel should conduct joint training sessions to clarify which needs and services each has to offer. Ground personnel should receive training in aircraft safety, airborne

communications and engagement, and medical performance inside the cabin. Air crews should receive appropriate training to fill the additional roles required during a MCI such as triage and registration. Incident Air Support Managers should be trained properly for future events and an Air Support Manager instruction kit should be developed. This kit must include specific directives to assure the establishment of prompt, direct communication between the Air Support Manager and the air crews. Registration methods should be standardized among various emergency medical services. An appropriate "MCI transfer procedure" should be adopted to shorten casualty transfer time to the emergency department and enable crews to continue with airborne evacuations.

The AME system should be prepared to adjust crew configurations to address each specific incident response requirements; for example, splitting crews and using ground personnel within existing crews during air transport. This event emphasized the necessity for flexibility in medical decision-making and the need for non-conventional solutions regarding crew compositions during the management of an air-evacuation operation in similar settings.

Following this train crash, the AME proved to be an essential component of the medical responses that enabled the prompt transportation of casualties from the incident site to trauma centers and a reasonable distribution of patients between various centers in the region. These benefits should be considered during future MCIs in settings where AME is available.

References

1. Rhee KJ, Burney RE, Mackenzie JR, *et al*: Therapeutic intervention scoring as a measure of performance in a helicopter emergency medical services program. *Ann Emerg Med* 1986;15:40–43.
2. Burney RE, Fischer RP: Ground versus air transport of trauma victims: Medical and logistical considerations. *Ann Emerg Med* 1986;15:1491–1495.
3. Frazer R: Air medical accidents— A 20 year search for information. *Air Med J* 1999;Sept/Oct:34–39.
4. Smith JS, Smith BJ, Pletcher SE, *et al*: When is air medical service faster than ground transportation? *Air Med J* 1993;Dec:258–261.
5. Schiller WR, Knox R, Zinnecker H, *et al*: Effect of helicopter transport of trauma victims on survival in an urban trauma center. *J Trauma* 1988;28:1127–1134.
6. Gearhart PA, Wuerz R, Localio AR: Cost-effectiveness analysis of helicopter EMS for trauma patients. *Ann Emerg Med* 1997;30:500–506.
7. Baxt WG, Moody P: The impact of a rotorcraft aero-medical emergency care service on trauma mortality. *JAMA* 1983;249:3047–3051.
8. Baxt WG, Moody P, Cleveland HC, *et al*: Hospital-based rotorcraft aeromedical emergency care services and trauma mortality: A multi-center study. *Ann Emerg Med* 1985;14:859–864.
9. Burney RE, Rhee KJ, Cornell RG, *et al*: Evaluation of hospital based aeromedical transport programs using therapeutic interventions. *Aviat Space Environ Med* 1988;59:563–566.
10. Moylan JA, Fitzpatrick FT, Beyer J, *et al*: Factors improving survival in multisystem trauma patients. *Ann Surg* 1988;207:679–685.
11. Schwartz RJ, Jacobs LW, Juda RJ: A comparison of ground paramedics and aero-medical treatment of severe blunt trauma. *Conn Med* 1990;54:660–662.
12. Hotvedt R, Kristiansen S, Forde OH, *et al*: Which groups of patients benefit from helicopter evacuation? *Lancet* 1996;247:1362–1366.
13. Urdaneta LF, Miller BK, Ringenberg BJ, *et al*: Role of an emergency helicopter transport service in rural trauma. *Arch Surg* 1987;122:992–996.
14. Ammon MA, Moore EE, Pons PT, *et al*: The role of regional trauma system in management of a mass disaster: An analysis of the Keystone, Colorado chairlift accident. *J Trauma* 1988;28:1468–1471.
15. Martin TE: The Ramstein air-show disaster. *J R Army Med Corps* 1990;136(1): 19–26.
16. Maningas PA, Robison M, Mallonee S: The EMS response to the Oklahoma City bombing. *Prehospital Disast Med* 1997;12(2):80–85.
17. Romundstad L, Sundnes KO, Pillgram-Larsen J, *et al*: Challenges of major incident management when excess resources are allocated: Experiences from a mass casualty incident after roof collapse of a military command center. *Prehospital Disast Med* 2004;19(2):80–85.
18. Barbash GI, Ribak J, Revach M, *et al*: Management control of aero-medical evacuation systems. *Aviat Space Environ Med* 1988;59:172–175.
19. Jacobs LM, Sinclair A, Beiser A, *et al*: Pre-hospital advanced life support: Benefits in trauma. *J Trauma* 1984;24:8–13.
20. Liberman M, Mulder D, Lavoie A, *et al*: Multi-center Canadian Study of pre-hospital trauma care. *Ann Surg* 2003;237(2):153–160.
21. Rainer TH, Houlihan KPG, Robertson CE, *et al*: An evaluation of paramedic activities in pre-hospital trauma care. *Injury* 1997;28:623–627.
22. Sukumaran S, Henry JM, Beard D, *et al*: Pre-hospital trauma management: A national study of paramedic activities. *Emerg Med J* 2005;22:60–63.
23. Baxt WG, Moody P, Cleveland HC, *et al*: Hospital based rotorcraft aeromedical emergency care services and trauma mortality: A multi-center study. *Ann Emer Med* 1985;14:859–864.
24. Hamman BL, Cue JI, Miller FB, *et al*: Helicopter transport of trauma victims: Does a physician make a difference? *J Trauma* 1991;69:3246–3250.
25. Burney RE, Passini L, Hubert D, *et al*: Comparison of aero-medical crew performance by patient severity and outcome. *Ann Emer Med* 1992;21:375–378.
26. Rodenberg H: The Revised Trauma Score: A means to evaluate aero-medical staffing patterns. *Aviat Space Environ Med* 1992;63:308–313.
27. Burney RE, Hubert D, Passini L, *et al*: Variation in air medical outcomes by crew composition: a two-year follow-up. *Ann Emer Med* 1995;25:187–192.
28. Cameron PA, Flette K, Kaan C, *et al*: Helicopter retrieval of primary trauma patients by a paramedic helicopter service. *Aust NZ J Surg* 1993;63:790–797.
29. Baxt WG, Moody P: The impact of a physician as part of the aero-medical pre-hospital team in patients with blunt trauma. *JAMA* 1987;257:3246–3250.
30. Garner A, Rashford S, Lee A, *et al*: Addition of physicians to paramedic helicopter services decreases blunt trauma mortality. *Aust NZ J Surg* 1999;69:697–701.
31. Bartolacci RA, Munford BJ, Lee A, *et al*: Air medical scene response to blunt trauma: Effect on early survival. *Med J Aust* 1998;168:610–615.

Editorial Comments—Role of Aeromedical Evacuation in Mass-Casualty Incident: A Train Collision Experience

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This article provides an important case study of the value of air-medical evacuation (AME) services for responses to mass-casualty incidents.

The introduction includes a discussion of AME services in "non-disaster or military settings". The authors state, "Controversy exists concerning the value of air-medical versus ground transportation in any setting. The advantages of AME include rapid transportation to a receiving facility and better access for rural and wilderness rescue." However, in some parts of the world, AME is the only viable means of transporting acutely ill and injured patients from remote rural or wilderness areas to definitive medical care. Although this article focuses on helicopter AME in Israel, in larger, more remote geographic areas (e.g., the western United States, Alaska, Canada, Australia, etc.), AME also includes fixed-wing aircraft with longer ranges and greater speed. Organizing fixed-wing AME response to mass-casualty incidents requires some logistical issues not addressed in this case study.

In this event, there were 289 casualties, resulting in a ground response of 79 ambulances with a total of 167 medical personnel. The ground response was supplemented by six helicopters with a total of 43 medical personnel. This was an impressive response, and far exceeded the capabilities of emergency medical services in most small towns and rural areas in other nations.

Important lessons can be learned from this event, which could help improve the response to future mass-casualty incidents in other regions.

Among the successes were:

1. Initial response and subsequent transport of patients by AME to medical facilities were relatively rapid;
2. Air-medical evacuation teams were assigned to triage side-by-side with ground medical teams;
3. Air-medical evacuation crew composition was modified to adapt to the high number of casualties versus the number of medical personnel available, including the use of ground medical personnel to supplement air medical crews;
4. The AME was managed at the scene by an IAF-SAR Unit Commander and a physician trauma specialist who were transported to the scene by the first helicopters. They directed helicopters to appropriate landing zones, assigned medical teams to patients, and set priorities for loading;
5. Air-medical evacuation was used as a "feeding channel" of medical reinforcement personnel to the scene;
6. Information about the incident was provided by the IAF Control Center to helicopter pilots, and it relayed messages to the AME helicopters regarding patient destinations from the Home Front Surgeon General Control Center;
7. Hospitals were notified by the Home Front Surgeon General Control Center through direct communications; and
8. Severely injured patients were evacuated by air to four Level-1 Trauma Centers located approximately 40–80 kilometers from the scene,

decreasing the burden on adjacent medical centers' emergency departments who were burdened by the less severely injured/ill.

Some lessons for future improvements for AME response to MCIs include:

1. Air-medical evacuation and ground medical crews should use the same triage severity tags, registration methods, and garments to help avoid confusion;
2. Air-medical evacuation sorties should hand-off patients quickly to hospital EDs so that they can return to service more rapidly;
3. Ground medical crews should train with AME crews to learn safety procedures, airborne communications, and caring for patients in the airborne environment in order to help minimize problems when they are required to work together;
4. Criteria for designating specific, safe landing zones should be established in advance;
5. "Geographical division of the scene, definitions of specific landing zones and assigning a commander to each scene would .... help.. control helicopter landings according to casualty concentration zones"; and
6. There should be a pre-assigned, common radio frequency for helicopters and air medical teams, and there should be immediate communications available between the air support manager and air crews. The Air Support Manager also should be integrated with the ground incident command as soon as possible, and Air Support Manager instruction kits should be developed.

Other nations and states can learn from Israel's example of providing IAF command and control of AME response to MCIs. Whether other jurisdictions use the military for this service, or civil authorities, it is necessary to designate an agency that has the responsibility for coordinating the complicated responses of multiple agencies to MCIs to help ensure the best possible outcomes.

With the lack of coordinated response of air-medical services in most states in the US and in other countries, consideration should be given to developing centralized air-medical dispatch systems, or at least some type of on-going coordination and monitoring system. The existence of coordinating or dispatch centers would help ensure appropriate and safer responses to routine medical and trauma emergencies and could be more easily and quickly expanded to coordinate responses to mass-casualty incidents.

This study provides an important contribution to the field of MCI response.