Triage and Air Evacuation Strategy for Mass Casualty Events: A Model Based on Combat Experience

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ABSTRACT  Background: Management of combat casualties should optimize outcomes by appropriate patient triage, prehospital care, and rapid transport to the most capable medical facility, while avoiding overwhelming individual facilities. Methods: Planning the medical support for the campaign was done by the medical department of the IDF Southern command in cohort with the medical department of the Homefront command. Data collection and analysis were done by the Trauma Branch of the Medical corp. Results: 339 soldiers were injured, among them were 10 fatalities. Five hospitals received casualties, although the 2 regional hospitals received 84% of the primary evacuation load. The majority of urgently injured soldiers (90%) were evacuated by air, as opposed to 59% of non-urgently injured soldiers. Conclusions: In a cross border setting, airlifting the urgent casualties to farther away level I trauma centers provides appropriate care for them, while not crossing the “surge capacity” line for the near-by medical centers.

INTRODUCTION

Triage and treatment by advanced life support (ALS) providers and rapid evacuation remain the corner-stones of medical assistance by medical corps worldwide. Contingency plans for evacuation of casualties in various combat theaters exist. The January 2009 campaign in the Gaza strip qualified as a near border theater, and planning of medical support for this campaign was done.

Evacuation of casualties from the combat zone is managed by armored personnel carriers, tanks, armored vehicles, ambulances, and airlifts, depending on availability, medical urgency, and war zone characteristics (eg, anti-tank fire precludes evacuation by insufficiently armored vehicles).

Medical urgency of evacuation is dictated by an ALS provider. The level of urgency can be designated as (1) urgent, meaning immediate evacuation is necessary. Danger exists for life or limb. (2) Non-urgent, meaning no danger exists and evacuation can be postponed until available. This method of prioritizing casualty evacuation was developed from lessons learned from previous conflicts and reinforced in the 2006 2nd Lebanon war.1–3

The medical system in the southern region of Israel includes 2 hospitals. One is a Level 1 Trauma center located 40 km from the Gaza border, and the other is a Level 2 center located 17 km away. Evacuation time to these hospitals from the border is 30–40 and 15–20 minutes, respectively, by ground and 10–15 and 5–7 minutes, respectively, by air. Farther away in the central region of Israel are located four Level 1 trauma centers, which are 12–20 minutes away by air (Fig. 1). These evacuation times do not include extraction time from the combat zone to the border and, therefore, do not reflect total time of evacuation.

During the 2nd Lebanon war, 591 casualties were evacuated and treated in hospitals. Among them, 549 (93%) were in the three hospitals of the northern region of Israel. The one level I trauma center in the region (Rambam medical center) received 75% (52/68) of severely injured casualties (out of a total 218 evacuated to this center). One of the primary lessons learned was that a plan has to be drawn that distributes urgent casualties between several trauma centers to provide the best care, without stretching each center’s capabilities beyond the optimal capacity.

The objective of this report was to describe and discuss the planning and execution of the primary evacuation and the redistribution of casualties during operation “Cast Lead.”

METHODS

Pre-campaign Organization

National response to medical disasters or war is lead in Israel by the Supreme National Hospitalization Authority and implemented by the medical department of the Homefront Command in cohort with the Emergency branch of the Ministry of Health. The ministry is responsible for supplying real-time data on national resources, hospital occupancy, trauma ward occupancy, intensive care beds (ICU) occupancy, operation room capacity, blood bank reserves, available reserve medical personnel, and so on, and the HFC is responsible for maintaining a 24-hour active “war room,” with the facilities to communicate with relevant organizations or setups that either provide the center with information or receive information and operational instructions from it. This control center receives data from the regional commands regarding the amount and severity of injuries (gathered from combating...
Divisions), integrates this data with the data regarding national resources as described earlier, and supplies the national emergency medicine system (EMS) and the relevant army command with approved evacuation destinations along with number and severity of casualties approved for each destination. There is no direct communication between this command center and specific ALS providers.

The Campaign

Planning the medical support for the campaign was done by the medical department of the IDF Southern command in cohort with the medical department of the HMC. Planning the method of evacuation took into account several factors, chief among them were medical urgency and receiving hospital capabilities and type of transportation available. All ground evacuations were directed to 1 of the 2 regional hospitals. The decision whether to evacuate primarily to the level 1 center was made by the ALS provider on the scene. This decision could not be overruled from afar.

As a result of the relative proximity of several level 1 trauma centers by air, it was decided that all air evacuations would be made to such a center in the central region of Israel, which will be designated by the chief medical officer of the SC. This decision was because of the relative abundance of level 1 centers, although many casualties of war or of mass casualty incidents (MCI) can be treated sufficiently in level 2 centers.\(^3\)\(^-\)\(^6\) The distribution between centers would be based on the number of urgent casualties. The surge capacity of these centers is measured in the hundreds (20% of total hospital beds) and was not expected to be reached.\(^7\) This method was meant to keep regional medical centers occupancy low, taking into account the local civilian population, which was expected to be injured from mortar and missile attacks during the campaign. Flight destination could be changed to the regional level 1 center by the flight surgeons if called for by the severity of injury.

Post Event

All throughout the conflict and afterward data was collected prospectively by IDF Medical Corp. Data collection and retrospective analysis were based on several sources, most important of which was the questioning of all injured personnel and all medical care providers. This was performed by a dedicated group of investigators, enlisted especially for this mission, a lesson learned during the Second Lebanon war, 2006.

RESULTS

Operation “Cast Lead” in the Gaza strip took place during January 2009. During this operation, against the Hamas organization, 339 soldiers were injured, among them were 10 fatalities.\(^7\) Five hospitals were receiving casualties, with the 2 regional hospitals receiving 84% (278/330) of the primary evacuation load (Fig. 2).

On days when casualties numbered 10–15, nearly all were evacuated to nearby hospitals (Soroka medical center at Beer Sheva and Barzilai medical center Ashkelon). On 7 occasions, when the amount of casualties rose above 20 per day, primary distribution also included hospitals located in central Israel (Rabin medical center and Chaim Shiba medical center). On 1 day (January 5, 2009), when the number of casualties reached 48, with many urgently injured soldiers, some were evacuated to Hadassah Ein Carem medical center at Jerusalem as well.

A total of 194 of 339 soldiers were injured during combat. Distribution between air and ground evacuation of these casualties is shown in Figure 3. The majority of urgently injured soldiers (90%, 55/61) were evacuated by air, as opposed to 59% (78/130) of non-urgently injured soldiers. In 1 MCI on January 5, 2009, 30 soldiers were injured with 20 triaged initially as urgent, 7 non-urgent, and 3 killed in action. Twenty-one were airlifted to hospital in 6 sorties (20/20 urgent and 1/7 non-urgent) and the rest were ground evacuated.

During Cast Lead, 33 air evacuations took place. In 25 of these missions, the original flight destination was completed as planned. In 8 missions, flight destination was changed to...
a regional level 1 medical center (Soroka, Beer Sheva) because of medical reasons (3 missions) or operational reasons (5 missions). A summary of flight destinations as flown eventually is shown in Table I.

A major factor in performing primary distribution of casualties between medical facilities is occupancy and availability. Accumulation of admissions of soldiers in the major receiving hospitals is shown in Figure 4.

Percentage of urgent casualties out of the total number evacuated to each of the 5 receiving hospitals was calculated: Barzilai 4.3%, Soroka 20.2%, Shiba 66.7%, Rabin 84.2%, and Hadassah 100%.

Eighteen patients were secondarily transferred to another treating hospital during “Cast Lead.” Of the total, 94.4% (17/18) were transferred from the 2 regional hospitals near the combat zone (Soroka 8 and Barzilai 9). Of the total, 94.4% (17/18) were transferred during the first week of the campaign (4 on January 5, 2 on January 6, 8 on January 7, and 3 on January 9), during days when the total number of casualties was above 40. Urgent patients (7) were transferred to level 1 centers while non-urgent patients (11) were sent to a variety of regional hospitals in proximity to their place of residence.

**DISCUSSION**

Matching a casualty’s needs to the appropriate resources starts with field triage. Ideally, casualties are transported to the most appropriate facilities. This destination selection must be based on the best assumption of a patient’s needs, on the individual hospital’s capabilities and capacities, and the system’s available resources.8–10 For the critically injured, trauma centers have been demonstrated to have the best outcomes, and their utilization should be optimized.11–14

Optimally, casualty’s needs must be balanced by avoiding any overwhelming particular facility. Patient mal-distribution, such as triage error, overwhelming receiving centers, or transporting casualties to hospitals not capable of caring for them is caused partially by inherent errors in planning the medical response or by errors in the execution of said plans.8,15–17

Israel has suffered many terrorist attacks on its civilian population during the past decade.3–6,18,19 Those events taught the civilian EMS that evacuating the most urgent casualties to the nearest hospitals and evacuating the more mild casualties to more distant medical centers has a major effect in preventing overwhelming of medical facilities. This method of operation, very relevant to the civilian urban setting with its many medical facilities, is less relevant to the military setting, even a near-border one, but the principle of primary distribution of casualties based on medical urgency is the same.

Even performing the best triage between urgent and non-urgent casualties does not solve the problem of scarcity of hospitals in the proximity of the combat zone. The only method of performing primary distribution to further away located hospitals is by shortening the transit time, which can be achieved by performing a large number of air evacuations of casualties.

Since air evacuation is a limited resource (because of different operational factors), most casualties evacuated using this route were urgent, although more non-urgent casualties were transported by ground vehicles, as described earlier for a specific event on January 5 and as shown in Figure 3. This distribution was anticipated, and therefore, the decision was made that air evacuations will be primarily routed to farther away trauma centers. By these means, all air evacuated urgent
casualties receive the best care available and the hospitals in the proximity of the combat zone are kept at a lower occupancy level and at a higher level of readiness for receiving a large surge of casualties if needs be. This method of lowering evacuation of soldiers to local hospitals gains further merit when taking into account the shelling of civilians before and during the campaign and the number of casualties among them that were being evacuated and treated. As expected, during the campaign, over 1,000 civilian casualties were treated by regional medical centers, as reported by the national EMS (>90% non-urgent and ≈75% acute stress injuries).

Taking into account the concept just described, careful studying of Figure 2 shows a large amount of casualties evacuated to Soroka medical center on 3 occasions (January 4, −24, 8 urgent, January 5, 18, 6 urgent, January 17, 23, 2 urgent). January 4 was the first day of true combat casualties, and 6 air sorties were distributed between 3 receiving hospitals. January 5 had the MCI described earlier, and 8 air sorties were distributed between 5 receiving hospitals. January 17 was at the third week of the campaign, and most of the casualties were not combat-oriented (18/24), non-urgent (22/24), and ground-evacuated (22/24). In all 3 days, the number of urgent triaged casualties transferred to this hospital was low, below its surge capacity.

The ability to evacuate by air all the way to a farther located medical center depends on the number of casualties and the number of aircraft dedicated to this mission. On a larger scale campaign or a multi-theatre war, there may arise a conflict between flying longer sorties with fewer casualties all the way to central Israel or flying shorter sorties with more casualties to regional medical centers, thus eliminating the advantages described earlier, but achieving a shorter transit time for more casualties. Both options are valid and both will probably be applied in a large scale conflict.

With respect to the plans made, the data shows that 42.5% (14/33) of air evacuation missions landed in Soroka medical center, a regional trauma center, and not in central Israel. The first 2 missions were flown on the first day of ground operations (4.01) before any accumulation of admissions had occurred. Five of these missions were primarily routed to farther away hospitals, but rerouted on flight. Three of these were rerouted by the flight surgeons because of the medical conditions of casualties. Another 2 were rerouted by air control because of combat related factors. Seven more missions were primarily directed locally, as opposed to the plans described. One of these was because of the severity of injury, which was eventually fatal. Three of these missions were flown on January 5, which was the day with the highest number of casualties in the entire campaign. Nine air evacuation missions were flown on that day almost simultaneously, because of an MCI, and distributed among the different receiving hospitals (Fig. 2). Three more missions of the 7 directed locally where flown on final days of the campaign (14.01, 17.01). This route was given because of the relatively high occupancy level of the medical centers in central Israel, which received mostly severely injured casualties up to then, compared to the local trauma center, which at the time was less occupied (Fig. 4). This analysis demonstrates the spectrum of different factors influencing the primary distribution of casualties, whether medical (severity of injury and facilities available) or military (evacuation availability and air control guidelines).

Having discussed the primary distribution during the campaign, describing the entire course of events requires discussing the redistribution between medical centers. A total of 18 casualties were transferred secondarily between hospitals. None of these transfers was a result of a casualty reaching a hospital unable to handle his injury, because of the successful primary distribution. Of the total, 94.4% were transferred during the first week of the ground campaign. And 94% of these were transferred from the 2 regional hospitals to different hospitals across Israel. These events were a result of the number of casualties during the first week of the campaign. During this week, the number of casualties was the highest in the entire campaign (Fig. 2). As a result, many casualties (mostly non-urgent) were admitted to the 2 local hospitals. In an attempt to lower the occupancy rate of these hospitals and to raise their readiness for further surges, redistribution was performed. All urgent casualties were transferred to the trauma centers, according to their specific injuries and place of residence (if applicable), and all non-urgent casualties were transferred to hospitals closer to home. Some of these patients were transferred to rehabilitation centers. This process was so successful that, during the second week of the campaign, casualties were primarily transferred to regional hospitals because of their lower occupancy level, as stated earlier.

**SUMMARY**

The Israeli campaign in the Gaza strip during January 2009 was foreseen before it took place. Plans were made to achieve the best medical care possible for the injured, all the while preventing medical facilities from being overwhelmed by the volume of casualties. The detailed plans outlined in this report for performing primary distribution and redistribution of casualties were upheld, almost to the letter, for most of the campaign, with satisfactory results. Although the plans used in this campaign were successful, it is the planning process that is to be commended, and the detailed factors that were taken into account (medical urgency, availability of evacuation, and available medical system resources) that need to be remembered in planning processes in the future. In the words of Dwight D. Eisenhower: plans are nothing, planning is everything.

**REFERENCES**

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