Medical Evacuation and Triage of Combat Casualties in Helmand Province, Afghanistan: October 2010–April 2011

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ABSTRACT  Medical evacuation of combat casualties in Operation Enduring Freedom-Afghanistan is achieved primarily by helicopter, because of distances involved as well as ground-based threats. In Helmand Province, evacuation from the point of injury may occur on a variety of helicopter evacuation platforms with disparate levels of attendant medical expertise. Furthermore, triage to a medical treatment facility may involve varying echelons of care before definitive management. Consequently, considerable differences in medical care may be encountered between point of injury and definitive treatment. We discuss the role of helicopter-based medical evacuation in Helmand, Afghanistan, as well as triage and timelines to the most appropriate medical facilities. Based on our experience and available evidence, we have made recommendations to regional commanders which favor the utilization of prehospital critical care teams aboard helicopter-based evacuation platforms and direct triage to the highest echelon of care available when feasible.

INTRODUCTION

Medical evacuation (MEDEVAC) and triage of combat casualties in Helmand Province, Afghanistan, involves a joint service, multinational system, with a wide range of capabilities, delivering care in a hostile, austere environment. Decisions regarding MEDEVAC tasking and triage of combat wounded to the most appropriate medical facility are driven by a number of influences. These include mechanism or type of injury, patient stability for transport, evacuation timelines, availability of assets, and prevailing tactical and weather conditions. Additionally, historical precedents and biases along the decision chain play considerable roles. Such decisions occur in a complex medical battle space, and evidence to support or refute current practice is continually evolving as lessons learned from Operation Iraqi Freedom (OIF) and Operation Enduring Freedom (OEF) are identified.1

Several controversial decisions regarding MEDEVAC tasking and implementation, as well complications during primary and secondary transport, occurred in Helmand Province during the period between October 2010 and April 2011. These events were reviewed by a multinational group of peers, and evidence-based recommendations were made to regional commanders in an effort to effect performance improvement. Based on a review of pertinent literature and our own experiences at UK Role 3 Hospital Bastion, we discuss the role of helicopter-based MEDEVAC in Helmand Province, Afghanistan, as well as triage and timelines to the most appropriate medical facilities, in keeping with the motto of “right patient, right care, right time.”

DISCUSSION

The “Golden Hour” in Military Trauma

The concept of a “golden hour” in trauma has circulated for over 35 years and has long influenced the doctrine of military medicine despite a lack of clear supporting evidence. In OEF-Afghanistan, the U.S. doctrinal timeline for evacuation of “urgent” casualties to a NATO Role 2 or 3 medical facility is less than 60 minutes, despite a published NATO standard of 90 minutes (Control and Coordination of Medical Evacuation within Regional Command Southwest [RC(SW)]. Annex B (Ed 2) to RC(SW) SOP 6001, June 2010). Any mission which exceeds this self-imposed 60-minute limit is subject to a delayed mission report. For reasons we will describe, it is our opinion that strict and arbitrary adherence to this “golden hour” may be at odds with optimal patient care in the current conflict in Helmand Province and may have the potential to result in additional morbidity and mortality. This may occur by suboptimal tasking of MEDEVAC assets, triage to a less-resourced medical facility and/or aviation mishaps.

Recent literature has refuted the concept of the golden hour, and multiple studies have largely failed to demonstrate an association between prehospital times and mortality in either the civilian or military setting.2–6 Military trauma differs from its civilian counterpart in several important ways, but relevant to this argument is the temporal distribution of death.

On the battlefield, historical evidence suggests a bimodal distribution of death, with the first peak secondary to catastrophic injuries within 15 minutes of wounding. The second peak of death is reported to occur between 60 and 180 minutes after wounding.7 It is unclear what effect implementation of current Tactical Combat Casualty Care guidelines and liberal tourniquet use might have on this figure in current conflicts. Immediate surgical intervention within the first 15 minutes after wounding has been shown to have no impact on survival; so, there appears to be no role for placement of extremely far-forward surgical assets.8 Therefore, emphasis has been logically placed on
Echelons of Care on the Modern Battlefield

Initial experience with dynamic, large scale invasion and conventional warfare in Iraq resulted in the concept of forward deployed medical and surgical teams to stabilize casualties close to the point of injury before evacuating to more definitive care, which often required prolonged evacuation timelines. “These units were designed and staffed to support maneuver warfare in an immature theater where Role 3 medical facilities were not readily available (HR Bohman, personal correspondence).” The birth of highly mobile Forward Surgical Teams and Surgical Shock Trauma Platoons proved successful in this environment and outcomes were reported as equivalent to Role 3. NATO classification of these units would be Role 2+, with limited surgical and holding capacity, whereas Role 3 is defined as a field hospital, with specialist surgical and other advanced capabilities.

As the battlefield matured and Role 3 field hospitals became more readily accessible, it became increasingly difficult to justify forward basing valuable surgical assets close to troop buildups. Nonetheless, this principle, whose foundation lies on the concept of a “golden hour,” has largely persisted in OEF-Afghanistan, where Role 2s are often forward deployed alongside combat troops.

Importantly, Role 2 medical assets are managed by operational commanders rather than an integrated, theater-wide trauma system, and placement is often independent of Role 3 hospital proximity. This has occasionally resulted in the two medical capabilities being placed within as little as 10 to 15 minutes of each other. We express concern that commanders may be tempted to position Role 2s for “peace of mind” without clearly understanding their value or their role within a coordinated trauma system, which currently provides rapid access to more capable Role 3s. When confronted with evidence refuting their utility in certain circumstances, doctrinal change to this approach has been met with resistance.

The utility of Role 2s in a mature battlefield is now being more closely scrutinized, especially considering the minimal difference in evacuation timelines from point of injury directly to Role 3s. We have found this difference in Helmand Province to be generally less than 20 minutes using available helicopter-based MEDEVAC, and total evacuation times remain less than 1 hour in most cases (Patient Evacuation Coordination Center RC(SW) unclassified data). In our experience, we have found that a delay in definitive care of 1 or more hours may occur when the patient is initially stabilized at Role 2 and secondarily transferred to Role 3. We believe this is largely unjustified when considering short evacuation timelines and the disparity in capabilities which exist between Role 2 and Role 3.

Controversies in Defining the Utility of Role 2

Role 2 capabilities are variable and dependent upon the composition of personnel and supplies, but resources are typically quite limited. As an example, the nominal requirement for blood stocks at typical Role 2 facility is 50 units of packed red blood cells, often with no other blood component therapy. A walking blood bank is also available, but its use incurs a delay of at least 30 to 40 minutes. This is often more than the time required for helicopter transfer to Role 3, during which transfusion of up to 8 units of blood products may be accomplished en-route.

Personnel experience at Role 2 is also variable, and trauma teams may be required to care for the most critically injured patients imaginable, with potentially insufficient recent experience and resources at their disposal. There exists a paradox, whereby these casualties require the most skilled and experienced clinicians and nursing staff, as well as the most rehearsed resuscitative teams; yet, they often operate in an environment which does not foster skills maintenance, with low patient volumes and acuity. We feel that the experience, skill, and teamwork required for optimal patient outcomes in severe polytrauma cases can only derive from recent exposure to a large number of seriously wounded patients with adequate resources. It is our opinion that these capabilities do not always exist at Role 2s.

Yet, despite scrutiny, there appears to be at least a limited role for Role 2 employment in the mature battlefield. Eastridge previously described comparable outcomes between a U.S. Army Forward Surgical Team (Role 2+) and the Combat Support Hospital (Role 3) in Iraq. Civilian data also supports the utility of Role 2 equivalent facilities in long-distance rural settings where stabilization by Advanced Trauma Life Support-trained providers is accomplished before transfer to a level 1 trauma center. This scenario may be analogous to stabilization at a remote Role 2, with secondary retrieval to Role 3 in less than 4 hours. However, this comparison is not clearly applicable to the current outlay of medical resources in Helmand.

Historical military evidence most clearly supports the utility of Role 2 in the immediate stabilization of hypotensive victims of isolated penetrating neck and torso trauma. These patients are known to benefit from early surgical intervention, and Chambers’ and Bohman’s experience in Fallujah, Iraq supports this conclusion. Just how early such surgical intervention is needed is less clear, but Bohman suggests 30 minutes as a limit in 3% of cases. However, in OEF-Afghanistan, patients with isolated penetrating neck and torso trauma account for less than 10% of combat casualties, and only 10% of these patients may have injuries which are ameliorable to immediate damage control surgery. This yields very little utility for far-forward deployment of valuable surgical resources on the battlefield, and
we argue that this capability may not be worth the associated costs in some cases.

**Arguments for Triage Directly to Role 3**

We feel that there are often convincing reasons to bypass Role 2 and triage the most critically injured polytrauma patients directly to Role 3 field hospitals. Historical evidence, personnel experience, resource management considerations, and evacuation timelines all seem to subjectively favor direct triage to Role 3 in many of our cases in Helmand. There is currently little objective evidence to resolve at what distance or evacuation timeline triage should proceed to Role 2 versus directly to Role 3 in the current setting, and this remains a subject for future study.

Civilian literature generally supports the transfer of trauma patients to the highest level of care available within the region, the level 1 trauma center, often bypassing lower echelons of care. In the military setting, this capability is represented by the Role 3 field hospital, whereas Role 2s may represent less-resourced community hospitals. We feel the current military trauma system in Afghanistan lacks the thorough integration between echelons of care which is present in civilian practice. It is our opinion that the military system stands to gain efficiency and improvement in trauma outcomes by revising and integrating the placement of medical facilities of all echelons of care across the battle space.

We find the most compelling argument for direct triage to Role 3 considers the material resources available to Role 2 versus Role 3 facilities. In our experience at UK Role 3 Hospital Bastion, a victim of dismounted improvised explosive device (IED) blast with multiple extremity amputations and severe polytrauma may require resuscitative procedures by a team of more than 10 physicians. Primary resuscitation of such a victim at Role 2 followed by more thorough resuscitation at Role 3 is detailed in Table I. We believe that the complexity and resource-intensive nature of such resuscitations exceeds the capabilities of most Role 2s and would render them materially incapable of managing the next critical casualties. However, this type of injury pattern and resuscitation is common in our experience at Bastion, where victims of IED-associated blast receive an average of 43 units of blood products during primary resuscitation (Table II). Initial stabilization of such patients at Role 2 is not known to improve outcomes, and we feel that, at best, it only serves to delay definitive treatment and exhaust Role 2 resources.

**TABLE I.** Resuscitation of IED Blast Victim With Bilateral Above Knee Amputations, Bilateral Upper Extremity Injuries, and Perineal and Genital Trauma

<table>
<thead>
<tr>
<th>Primary Resuscitation Role 2</th>
<th>Secondary Resuscitation Role 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Arrival: 0918 hours</td>
<td>Arrival: 1057 hours (1:39 hours after Role 2 arrival)</td>
</tr>
<tr>
<td>Tourniquets On</td>
<td>Blood Pressure 50/Palp</td>
</tr>
<tr>
<td>Intubated</td>
<td>Directly to Operating Room for continued surgical resuscitation</td>
</tr>
<tr>
<td>BE-25</td>
<td>Lactate 10</td>
</tr>
<tr>
<td>Temp 35.3</td>
<td>Blood Product Utilization in OR (1,058)</td>
</tr>
<tr>
<td>To Operating Room for Exploratory Laparotomy</td>
<td>24 units packed Red Blood Cells, 23 units Fresh Frozen Plasma,</td>
</tr>
<tr>
<td>Vascular Control of Common Iliacs, Faciotomy</td>
<td>6 units Platelets, 3 units Cryoprecipitate</td>
</tr>
<tr>
<td>Blood Product Utilization</td>
<td>Factor VIII and TXA</td>
</tr>
<tr>
<td>4 units packed Red Blood Cells, 3 units Fresh Frozen Plasma,</td>
<td>Calcium 5 g</td>
</tr>
<tr>
<td>1 unit Platelets: 0924–0940 hours</td>
<td>2 units Fresh Whole Blood</td>
</tr>
<tr>
<td>6 units Fresh Whole Blood: 1006 hrs</td>
<td>Resuscitative Team Makeup</td>
</tr>
<tr>
<td>Resuscitative Team Makeup</td>
<td>4 General Surgeons</td>
</tr>
<tr>
<td>2 General Surgeons</td>
<td>4 Anesthesia</td>
</tr>
<tr>
<td>1 Anesthesia</td>
<td>4 Ortho (2 Each Leg)</td>
</tr>
<tr>
<td>1 Ortho</td>
<td>1 Plastic Surgeon and Assistant</td>
</tr>
<tr>
<td>9 Line for Secondary Transfer: 1015 hours</td>
<td>Two Full OR Staffs</td>
</tr>
<tr>
<td>Wheels Up for Secondary Transfer: 1039 hours</td>
<td>Time to Normal in Vitro Clotting &amp; Temperature</td>
</tr>
<tr>
<td>Temp 36.3, BE Not Accurate (Bicarb Given)</td>
<td>1150 hours</td>
</tr>
<tr>
<td>Total Time @ Role 2: 0918-1039 hours</td>
<td>0:53 hours after arrival at Role 3</td>
</tr>
<tr>
<td>1:21 hours after arrival at Role 2</td>
<td>2:14 hours after arrival at Role 2</td>
</tr>
</tbody>
</table>

**TABLE II.** Blood Product Utilization at UK Role 3 Hospital Bastion From October to December 2010

<table>
<thead>
<tr>
<th>All Patients</th>
<th>Massive Transfusions</th>
<th>74</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total No. of Blood Products Given</td>
<td>2,602</td>
<td></td>
</tr>
<tr>
<td>Average No. of Blood Products/Patient</td>
<td>34 (Maximum 112)</td>
<td></td>
</tr>
<tr>
<td>Average No. of pRBC/Patient</td>
<td>15 (Maximum 44)</td>
<td></td>
</tr>
<tr>
<td>Average No. of FFP/Patient</td>
<td>15 (Maximum 47)</td>
<td></td>
</tr>
<tr>
<td>Average No. of PLT/Patient</td>
<td>3 (Maximum 7)</td>
<td></td>
</tr>
<tr>
<td>Average No. of Cryo/Patient</td>
<td>1 (Maximum 5)</td>
<td></td>
</tr>
<tr>
<td>Patients With IED Blast and Extremity Amputations</td>
<td>Massive Transfusion</td>
<td>33</td>
</tr>
<tr>
<td>Total No. of Blood Products Given</td>
<td>1,415</td>
<td></td>
</tr>
<tr>
<td>Average No. of Blood Products/Patient</td>
<td>43 (Maximum 112)</td>
<td></td>
</tr>
<tr>
<td>Average No. of pRBC/Patient</td>
<td>19 (Maximum 44)</td>
<td></td>
</tr>
<tr>
<td>Average No. of FFP/Patient</td>
<td>18 (Maximum 44)</td>
<td></td>
</tr>
<tr>
<td>Average No. of PLT/Patient</td>
<td>4 (Maximum 17)</td>
<td></td>
</tr>
<tr>
<td>Average No. of Cryo/Patient</td>
<td>2 (Maximum 5)</td>
<td></td>
</tr>
</tbody>
</table>
Another, often overlooked, consideration for triage directly to Role 3 is minimization of risk to MEDEVAC crews and aircraft. Initial stabilization at Role 2, followed by secondary transfer to Role 3, results in two separate MEDEVAC missions, with a doubling in exposure to a hostile environment and the potential for aircraft mishap and loss of life and property. Additionally, secondary transfers are often associated with a downgrade in the level of care provided to the trauma patient, with subsequent risk of clinical deterioration.

Integration of Prehospital Critical Care into the Military Trauma System

The keystone of an integrated trauma system is the provision of appropriate prehospital care, and evidence clearly supports this. In OEF-Afghanistan, prehospital care and transport to field hospitals is primarily accomplished by helicopter-based MEDEVAC. Within NATO, the skill mix of MEDEVAC crews varies across evacuation platforms and according to the participating nations’ own MEDEVAC doctrine, but in Helmand Province, the spectrum of helicopter-based prehospital medical capabilities may be summarized as follows:

1. 1 × Emergency Medical Technician-Basic aboard U.S. Army “Dustoff” UH-60A Blackhawk.
2. 2 × Emergency Medical Technician-Paramedic aboard U.S. Air Force “Guardian Angel” HH-60 Pavehawk.
3. Critical care transport team (1 × Emergency Physician or Anesthesiologist, 2 × Paramedic, and 1 × Emergency Nurse) aboard UK Medical Emergency Response Team (“MERT”) modified CH-47 Chinook.

In the civilian setting, several authors have noted that a higher level of prehospital clinical capability leads to decreased mortality despite longer evacuation timelines.\(^{18-20}\) These findings are in keeping with the UK military experience in Helmand and drive the physician-led UK MERT model. Using this model, during a 3-month period in 2009, the rate of unexpected survivors as a result of en-route, physician-led critical care and direct triage to Role 3 was 14.9 per 100 patients, calculated by Trauma Injury Severity Score methodology (JTTC Database Academic Department of Military Emergency Medicine, Birmingham, England.). During the same period, the rate of unexpected survivors by U.S. MEDEVAC was 4.8 per 100 patients (MS Support to CJCS Guidance, June 2010). Notably, during this period, the mean time to Role 3 for the most seriously injured British casualties in Helmand was 99 minutes, in contrast to significantly shorter current timelines.\(^{21}\)

The crew composition of UK MERT is similar to that of the recently described U.S. Navy Mobile Trauma Bay, as is the clinical capability to provide lifesaving interventions such as RSI, intubation and mechanical ventilation, tube thoracostomy, and hemoctytic resuscitation with blood products. Thus, UK MERT may be considered analogous to a helicopter-based Mobile Trauma Bay and is capable of providing critical care within a mean time of less than 40 minutes after 9 line MEDEVAC request (Fig. 1). These (Role 2 equivalent) interventions continue en-route to the receiving medical facility, with an average on-scene time of less than 60 seconds (Patient Evacuation Coordination Center RC(SW) unclassified data).

Additionally, the flight physician is able to provide input as to whether evacuation should proceed to Role 2, Role 3, or another theater-level asset such as a receiving neurosurgical facility. We feel this comprehensive package of clinical capability, experience, and judgment surpasses the capabilities of crews aboard traditional U.S. tactical MEDEVAC platforms, and they should not be judged as equivalent capabilities (Davis PR, Griffiths A, Nadin MN: Delivering Tactical Prehospital Critical Care—The Emergency Medical Response Team, 2006).

Controversies in Prehospital Care

Debate continues to flourish surrounding the philosophies of “scoop and run” versus “stay and play” during the prehospital response, and there are varying opinions as to whether a physician should be core to the MEDEVAC team. However, various reviews of the literature seem to indicate more favorable outcomes for victims of polytrauma, severe traumatic brain injury, and major thoracic injury when prehospital critical care teams attend the patient.\(^{22,23}\) This is the basis of the UK and Israeli Defence Force doctrine for physician-led, MEDEVAC crew composition. Additionally, international civil trauma system models for physician-led, prehospital critical care teams exist in Europe (Austria, France, Germany, Italy, Spain, Switzerland, and United Kingdom) and in Australasia (Australia & New Zealand).

In the military setting, there is clearly a spectrum of medical response appropriate to the mechanism and pattern of injury. For example, the hemodynamically unstable victim of an isolated torso gunshot wound mandates rapid evacuation to the nearest capable medical facility for surgical control of noncompressible hemorrhage and does not require.
specialist prehospital care—this response favors “scoop and run.” Conversely, the comatose victim of an isolated head injury will benefit from early RSI and hemodynamic stabilization, with direct transfer to a neurosurgical facility—this response favors “stay and play.” Combining these divergent philosophies with short on-scene times and rapid provision of physician-led critical care, the UK MERT model has evolved to “stay and play while running as fast as possible in the right direction.”

Unfortunately, combat injury patterns are rarely clear-cut. Victims of dismounted IED blast may have a complex combination of neurological injury, extremity amputation, and hemorrhage, as well as intrathoracic, intra-abdominal, and/or pelvic injury. Intuitively, it might be assumed that these patients would benefit from immediate evacuation to the nearest medical facility, and this assumption has seemingly influenced current U.S. MEDEVAC practice. However, the available evidence argues that severe polytrauma patients have improved outcomes from early en-route critical care and direct transfer to Role 3 or the civilian equivalent.24

Secondary Transfer of Combat Casualties
The underpinning principle of secondary transfer is the need to move the trauma patient to a higher echelon of medical care. This commonly occurs after a patient has been stabilized at a Role 2 facility and requires transfer to Role 3 for more definitive care. Importantly, the level of care provided en-route must be equivalent to or higher than the level of care delivered by the referring facility and should be accomplished by a medical crew experienced in both critical care and transport medicine. This occurs routinely during intertheater tactical evacuation between Role 3 and Role 4 but is frequently lacking during intratheater transfer. We argue that the transfer crew should, ideally, include an experienced physician trained in anesthesiology, emergency medicine, or intensive care medicine with further training in transport medicine.25,26 This is an area of great contention, but we feel it demands further consideration in the combat setting to avoid unnecessary morbidity and mortality in the transfer of critically injured polytrauma patients.

As Role 3 receiving clinicians, we have observed several unfortunate scenarios which may portend worse outcome when secondary transfer is performed by inexperienced evacuation teams. It is well known that hypoxia and hypotension worsen traumatic brain injury and that lack of proper sedation and neuromuscular blockade may also aggravate intracranial pressure. Loss of airway control and/or accidental extubation en-route may be catastrophic, and each of these critical events correlates with poorer patient outcome.27,28 They may occur secondary to medical judgment or skill-based errors or as a result of the medical team’s unfamiliarity with the airframe or medical equipment.29,30 These challenges are further compounded by the frequent need to fly a tactical profile, often at night, in a high threat environment.

Human Factors and Critical Care Transport
The occurrence of adverse prehospital events in civilian literature has been correlated with the skill mix of medical teams, their familiarity with the transport platform, and their ability to integrate with other aircraft crew. Such “Human Factors” and “Crew Resource Management” issues are familiar in aviation and deficiencies are known to frequently contribute to aviation mishap causality.31,32

We feel that these facts support the existence of dedicated critical care transport or medical retrieval teams that are fully practiced in the transport environment, rather than being composed of ad hoc teams assembled for the occasional secondary transfer.33 This philosophy is encapsulated in guidance issued by the American College of Emergency Physicians,34 the Australasian College of Emergency Physicians,35 the Intensive Care Society of Great Britain,36 and such medical teams are the norm in Australasia and Europe. MEDEVAC crews require additional education and regular training to ensure currency in procedures and situations they may encounter in flight. The analogy to aviation Crew Resource Management is obvious, where a lack of training, familiarity, or currency would present an unacceptable risk to flight safety.

We feel the aforementioned risks could be mitigated by the incorporation of dedicated, specially trained, critical care MEDEVAC teams into an integrated, theater-wide military trauma system. These teams could be based at Role 3 field hospitals or forward deployed as operations and tactics directed, offering short evacuation timelines and early provision of critical care while en-route to the most appropriate medical facilities. Incorporation of such “flying mobile trauma bays” could even conceivably reduce staffing requirements at existing Role 2s, by allowing the most valuable medical and surgical resources to remain at the Role 3. We believe this model has the potential to improve patient care and safety while reducing costs and resource requirements associated with current battlefield trauma management.

CONCLUSIONS
In light of historical evidence, available resources and our own experiences in Helmand Province, Afghanistan, it is our opinion that the following recommendations be further investigated and seriously entertained by operational and medical commanders in OEF-Afghanistan/Op Herrick and future mature military theaters.

(1) A thorough restructuring of the deployed military trauma system should be undertaken to integrate all echelons of medical care across the battlefield, taking into account the fixed and mobile prehospital capabilities of all participating nations and services. Current best evidence regarding the “golden hour” and other lessons learned should be applied to this endeavor and defended when met with operational resistance.
(2) Dedicated, mobile prehospital critical care teams should be developed and employed for primary and secondary retrieval of the most seriously wounded combat casualties. Ideally, these teams should be physician-led and modeled after the highly experienced and successful international teams currently in existence. Thorough integration with the theater-wide military trauma system is essential.

(3) Critically wounded polytrauma victims should be retrieved by dedicated prehospital critical care teams and triaged to the highest and/or most appropriate level of medical care available within the region, in keeping with current civilian trauma systems and best evidence.

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