REVIEW ARTICLE

WAR CASUALTIES: RECENT TRENDS IN EVACUATION, TRIAGE AND THE 'GOLDEN HOUR'

Chaudhary Aqeel Safdar

Military Hospital Rawalpindi

ABSTRACT

Prompt medical treatment and early evacuation is the goal of military medicine in the battlefield. 'Triage' is a process of sorting the casualties according to the severity of injury and the prioritization of treatment. In trauma management 'Golden Hour' is the first sixty minutes or so after injury; this emphasizes that the chances of the victim's survival are the greatest if definitive care is given as early as possible. Our evacuation protocols follow the triage but the time to treatment is beyond sixty minutes. Many Armies have developed evacuation systems which allow the casualty to be seen within this specified time. This has been achieved by streamlining the evacuation chain, extensive incorporation of air transport and training of paramedics in advanced life support measures. In line with the modern trends we need to modernize our own system of casualty evacuation and treatment.

Keywords: War; Triage; Golden hour; Evacuation.

INTRODUCTION

The soldier is the army's most valuable asset in fighting and winning the battles. Prompt medical attendance and early evacuation allows combat commanders to continue their missions and build soldier's morale by demonstrating that care is quickly available if they are wounded. The goal of military medicine in the battle fields is thus preservation of combat strength and morale which must be maintained to strive for victory [1].

A high morbidity is expected in the battle scenario of today with the improved weapon systems, much higher rate of fire and killing capacity. The management of a single seriously injured casualty in peacetime military or civilian practice is frequently problematic. On the battlefield, problems are compounded by: environment, difficult terrain and tactical constraints. The situation is even more difficult when faced with large number of casualties [2].

If a system for prioritisation of care of the injured is not in place, many salvageable casualties may die unnecessarily. We must deliberate on change towards a field medical setup which provides optimum emergency care while ensuring a safe and rapid evacuation striving to provide treatment to those most in need, within a short time – the principle of the "Golden Hour".

The aim of this article is to review the principles of triage and the Golden Hour, with a view to applying these in the modern battlefields, thus improving the system of evacuation of casualties in line with the modern concepts.

Triage

Triage (from the French verb *trier*, to sieve or to sort), has evolved through military conflicts, dating from the Napoleonic Wars to recent civilian disasters. The process of triage is complex. The preferred definition is:

'Sorting casualties and the assignment of treatment and evacuation priorities to wounded at each tier of medical care'.

This should ensure the earliest possible diversion of seriously injured casualties to a surgical facility away from the flow of the majority of casualties in the evacuation chain [3]. The idea behind triage is that critically injured casualties with reversible injuries be transported and treated first. Less injured or fatally injured casualties are consigned to lower priorities of care. The concept of triage is

Correspondence: Lt Col Chaudhry Aqeel Safdar, TI(M) Psc, Classified Surgical Specialist, MH Rawalpindi
Email; aqeel_safdar@hotmail.com
Received: 09 Oct 2009; Accepted: 18 Nov 2009

intimately related to the principle of the **Golden Hour**

In trauma management, the **Golden Hour** is the first sixty minutes or so, after the occurrence of multi-system trauma. This term was advocated by Adam Cowley, first as a military surgeon and later as head of University of Maryland Shock Trauma Center [4]. It is widely believed that the victim's chances of survival are greatest if they receive definitive care within the first hour after a severe injury, when we have good chance of reversing the effects. Recent scrutiny has questioned the validity of the "golden hour" as a rigidly defined timeframe, although its core principle of rapid intervention in trauma cases remains universally accepted [5]. The patient may die or go into irreversible shock if not treated within this window. This makes their evacuation a higher priority. The lag time between the injury and treatment should ideally be kept to the minimum; this has been further standardized to around 60 minutes, the 'Golden Hour'. After this the survival rate of injured patients is alleged to fall off dramatically.

Evolution of Casualty Evacuation

In 270 AD, Romans developed first army hospital and believed not to waste human life on the battle field. Skillful first aid was administered to the injured, followed by proper convalescent setting for full recovery. Since it was highly impractical to send patients home or to far off hospitals it was necessary to establish portable hospitals near the battle field [1].

No list of famous figures is complete without the name of Larrey, Napoleon's Surgeon [6]. Jean Dominique was born in 1766, three years before his mighty master. After joining Napoleon's Army he realized that there was no good method of dealing with the removal of casualties from the field. The regulations demanded that the carriers for wounded had to remain where they were until after the engagement was over. After a victory, it could be several hours before evacuation began, but after a defeat, casualties were usually left abandoned where they lay.

Larrey's solution was the 'flying ambulance' (ambulance volante). These were horse drawn wagons for collecting wounded from the battlefield to the base hospitals. He described the system in minute detail from the Italian Campaign of 1797. At once its presence raised the morale of the French Revolutionary Army. It was soon copied by other nations.

It is possible that he was the first to think in terms of triage. He wrote:

"Those who are dangerously wounded should receive the first attention, without regard to rank or distinction."

Some French writers give Larrey credit for being the first to require that wounded from both sides be treated equally [6].

At the turn of the last Century in UK, the newly formed Royal Army Medical Corps faced its first test in the Boer War. This experience led to the formation of the Field Ambulance for the collection of casualties from front line units, their initial treatment at the Dressing Station and the transport of casualties to the Clearing Hospital. The large numbers of casualties and the stable front lines of the Western front of the World War I led to an increase in the size and capability of the Casualty Clearing Station (superseding the Clearing Hospital). The care of war wounded having been transformed by the concept of forward surgery [3].

This was found to be too large and immobile for World War 2. It was reorganised, and additional units created the Field Surgical Unit. The Cold War fixed British military medical planning to the challenge faced by huge numbers of surgical and nuclear casualties. This led to a casualty evacuation plan based on large fixed hospital facilities [3]. However, actual military operations in Suez, the Falklands Islands, the Gulf, Yugoslavia and Africa, showed that an easily deployable, clinically capable forward hospital facility was a critical component of a military medical system.

The field medical service in the US Army evolved the Mobile Army Surgical Hospital (MASH) during the Korean War. The Israeli Army, the Russian Army and the Croatian

Army evolved similar units to provide forward surgical support to military campaigns in the late 20th Century [3].

Present System of Triage and Casualty Evacuation in our Army

The Army Medical Corps is an administrative Medical service for the combat element of the Army, primarily concerned with the maintenance of health and fighting efficiency of the troops. In the field the process of evacuation works from front to the rear. Changes have been introduced; however the principle remains the same.

The chain of evacuation starts at the Regimental Aid Post (RAP) sited in close proximity of the unit headquarters. Next in line is the Advance Dressing Station (ADS), which primarily provides essential first aid and treatment. Another important function of ADS is sorting of casualties (Triage). The system followed is similar to that advocated by the Battle Advanced Trauma Life Support (BATLS) group of UK [2] although other systems also exist and have been tried [7]. The categories are:

- **Priority One (P1)**. Those needing immediate life-saving resuscitation and/or surgery.
- **Priority Two (P2)**. Those needing early resuscitation and/or surgery, but some delay is acceptable.
- **Priority Three (P3)**. Those who require treatment but where a longer delay is acceptable.
- **Priority Four (Dead or Dying)**.

This is the P (Priority) System of triage, which must be repeated at every link of the evacuation chain and the priority adjusted to reflect deterioration or improvement in the casualty's clinical condition [8]. NATO and Royal UK Navy use a similar system (the T system). The last priority (DEAD OR DYING) is not formally incorporated in our AMC triage system [9]. It needs to be implemented as the last priority, so as not to deprive the higher priority casualties a chance of urgent evacuation and treatment. This system has even more importance in the scenario of mass casualties (NBC) and disasters [10].

One of the principles of tactical employment of field medical units is that [9]:

- All casualties must be seen by the medical officer within four hours of injury
- Receive surgical treatment as soon as possible, but should not be delayed for more than 12 hours

Clearly, considering the Golden hour principle these times need to be decreased, drastically. This applies more so for the priority 1 cases. We need to work upon reducing the evacuation times for these seriously injured casualties. Newer timelines have to be implemented [11].

Evacuation Systems of the other Armies

We can expect a large number of our wounded soldiers to die if not evacuated safely and promptly. The modern Armies work on the principle of Golden hour, striving to reduce the evacuation time of those in dire need to within this hour. Nearly 30,000 U.S. troops have been injured in Iraq — about half of them with permanent disabilities. In Iraq and Afghanistan, troops who are wounded in an attack have a 95 percent chance of surviving [12]. It's the highest survival rate in the history of warfare. Once a serviceman is injured, they enter a kind of conveyer-belt of treatment that begins with an evacuation from the battlefield to the trauma ward. When the number of casualties is large, an effective triage system is implemented.

The two main doctrines on which the evacuation systems of the world armies operate are generally described as [13]:

1. 'Scoop and Run'

2. 'Stay and Play'

A lot of discussion has been generated over the last few years, using the experiences gained in Iraq and Afghanistan. There is no best system and the final word is awaited [14].

Scoop and Run Vs Stay and Play

The hot topic is: "Scoop and Run". It means to take the patient without primary treatment

and hurry him to the next hospital [13]. On the other hand, like the German, Israeli and British army, we practice the concept of "Stay and Play" in the case of a severely traumatized patient [13]. By administration of first aid, infusion therapy, early intubation and ventilation we try to avoid or at least minimize secondary, shock-related organ damage.

The prerequisite of Scoop and Run is a highly developed extraction and air evacuation of the casualties. This has been tried by the US Army in Iraq and Afghanistan conflict [14]. However we must remember the low intensity conflict situation in these areas, unlike full scale war. The topic of actual discussion is if a pre-hospital medical system is needed or if it can be replaced by a speedy transportation system. The majority of arguments in favor of "scoop and run" still come from the USA. A variety of researchers made it seem obvious that in case of severe hemorrhage speedy transportation to competent surgery is to be preferred. Having the surgeon on the battlefield with the soldier has been shown to make no difference to these survival rates [15].

The disadvantage of some of the American studies is that they lack in the patient selection, and include casualties of all types. They also do not include aggressive infusion therapy or patients who died prior to reaching the field hospital. There is no comparable data from European, Russian, Croatian and Israeli Armies. There, the "stay and play" system has been established. The studies are mainly based on comparison of data prior and after introduction of the system bringing an emergency physician or having a combat medic at the spot of the incident. In a study by Osterwalder from Germany 143 severely traumatized patients with high injury scores demonstrated that mortality of more than 50% 20 years ago has decreased to 10-15% in recent times. He was able to prove that not the shorter transportation time but the qualified medical treatment during the critical pre-hospital period was responsible for this significant improvement [13].

Studies done by the German Army stipulate that longer transportation times add to the physical strain of the patient and necessitate pre-hospital stabilization. This led to the suggestion that such a system should be abandoned in favor of early emergency treatment on site.

RECOMMENDATIONS

In combat circumstances the aim of the medical services must be to give care to the greatest benefit of the largest number - that is 'to do most for the most'. There have been many developments in this field, and we need to incorporate them in our system. The recommendations can be easily assimilated if the chain of evacuation from the FDLs (Forward Defended Localities) to the specialist hospital is kept in mind.

1. Collecting Zone: This describes the collection and sorting of casualties within the forward area. The use of armored ambulance vehicles will add some protection to stretcher bearers, improving evacuation times. The basic, physically demanding, task of carrying stretchers by hand remains. In recent years our battles have been fought in environments that are impassable to vehicles, such as mountains. However, casualties will need to be transferred to a vehicle at the earliest point in the evacuation chain. This may be an armored ambulance in mobile warfare, a helicopter in a difficult terrain or a mule in mountain warfare. Our primary casualty retrieval is excessively slow. A simple casevac request has to go through a lot of 'middle-management' before a flight decision is made. In Vietnam, wounded soldiers arrived in hospital within twenty-five minutes of injury. We use support helicopters that are re-roled on an adhoc basis for the critical care and transport of our sickest patients. We should continue to strive for a dedicated all-weather military helicopter evacuation fleet [16].

2. Skilled Resuscitation and Triage: Skilled resuscitation, known as Battlefield Advanced Trauma Life Support (BATLS) should be delivered within the Golden hour after wounding, as this is likely to substantially improve survival. A new breed of well trained paramedics (Combat Medics), proficient in BATLS, has to be incorporated at this point [17].

This can easily be achieved by short courses, followed by experience in the trauma centre of a hospital. They also need to triage the casualties according to the P-system described above, packaged and transported according to the urgency of situation. These Combat Medics can act as case managers increasing surge capacity by improving efficacy [18].Dead are the last priority and senior and junior field commanders have to be initiated into this doctrine.

3. Rapid evacuation (Golden Hour Principle): Following BATLS, some severe casualties will continue to deteriorate and require surgical intervention to control the immediate life threatening effects of wounding in order to complete their resuscitation. Incorporation of the Golden Hour principle needs to be adhered to. The present concept of taking up to 4 hours to be seen first has to be changed. It is based on this concept that new helicopters have been inducted in the role of air ambulances with trained staff on board. These need to be strengthened further and should become a part of every medical battalion.

4. Effective communication and coordination: For any concerted effort in saving of Priority 1 casualties, effective command and communication between the medical officer / trained paramedic, the evacuating team in their helicopters and the base hospital needs to be established. This is likely to cross the divisional rear boundary and involve the medical staff under the Corps Headquarters. Thus for optimum functioning this requires integral independent command and communications, without delay in making decisions and ordering response.

5. Role of Forward Treatment Centers (FTCs) and Military Hospitals: FTCs in the field work on bare minimum and this is because during peacetime their utility is limited. There is a need to revamp the Military Hospitals, with an emphasis on the Trauma related specialties. The FTCs in peace locations need to be attached with these hospitals, only to be detached and sent forward at the time of need. Thus increasing their utility in peacetime, while their staff gets continuous training.

6. Planning according to the new statistics: All our planning is still following the calculations drawn from the Second World War. The combat situations and firepower in today's battles have changed remarkably. Newer studies and data need to be incorporated for accurate planning. These can be our own experiences as well as published data in literature from the Iraq, Bosnia and Afghanistan conflicts, as well as major natural disasters [19]. It's time that we implement a standard form to be filled in for every combat casualty, at every level of evacuation, finally reaching a central registry. A number of such forms are available [20].

7. Logistics: The ideal shelter system for the FTCs would be simple to establish, weatherproof, robust, provide a suitable clinical environment and easy to operate. No such ideal system currently exists for field use [3]. Present concept of digging is useless and time consuming. Tents (soft-walled shelter systems) provide some benefit but may not be suitable for the wide range of environmental conditions. A number of surgical trailers and caravans have been developed. The evacuation hospital will need a reliable power source and field expedients for the provision of ample water instead of the ubiquitous jerry can. A hospital should have heating or air-conditioning to ensure optimum temperature of clinical areas [21]. In a hypothermic case of severe trauma the mortality is expected to increase up to four times [16].

8. New Adjuncts in the Field: In today's LIC battlefield the isolated combat medic needs to be equipped not only with the necessary skills but newer resuscitative aids. The first aid kit needs to be modernized and enhanced with portable oxygen saturation monitors and newer haemostatic agents like QuikClot® or Celox® [22].

CONCLUSIONS

In discussing casualty evacuation systems we need to critically think with reasoned debate to save the injured soldier. The process of triage is complex and provides only a 'snapshot' of how the casualty is at the time of assessment. It needs to be repeated at every link of evacuation

chain and in the process adjusting the priority to reflect the deterioration or improvement in the casualty.

The aim of any surgeon or paramedic is to save lives in any future wars that were just beyond their reach in the past. At the heart of that conviction is the Golden hour. The chances of survival are the greatest if surgery or BATLS can be provided within that hour. We must beat the clock. It isn't simply a golden hour; every minute is golden!

REFERENCES

1. Siddiqui MK Major. Trends in evacuation of casualties in the army. UCC Dissertation 2000; Armed Forces Postgraduate Medical Institute (AFPGMI). Rawalpindi.
2. Battlefield Advanced Trauma Life Support (BATLS). J R Army Med Corps 2000; 146: 215-27.
3. Bricknell MCM. The evolution of casualty evacuation in the 20th century (Part 5) – Into the future. J R Army Med Corps 2003; 149: 357-63.
4. Lerner EB, Moscati A. The Golden Hour: Scientific fact or medical "Urban Legend?". Academic Emergency Medicine 2001; 8: 758-60.
5. [Online] available from: http://en.wikipedia.org/wiki/golden _hour_(medicine) accessed 3 October 2008.
6. Blair JSG. Famous figures: James Dominique, First Baron Larrey. J R Army Med Corps 2005; 151: 207-8.
7. Malik ZU, Pervez M, Safdar A, Masood T, Tariq M. Triage and management of mass casualties in a train accident. J Coll Physicians Surg Pak 2004; 14: 108-11,
8. Lichtveld RA, Spijkers ATE, Hoogendoorn JM, Panhuizen IF, van der Werken Chr. Triage Revised Trauma Score change between first assessment and arrival at the hospital to predict mortality. Int J Emerg Med 2008; 1: 21-6.
9. Manual of AMC Training. GSP 1548. Part II. 1974. GHQ.
10. Bland SA. Mass casualty management for radiological and nuclear incidents. J R Army Med Corps 2004; 150: 27-34.
11. Strawder GS Lt Col. The Golden hour standard. Joint Force Quarterly (JFQ) 2006; 41 (2nd Quarter):60-7.
12. Raz G. Army Medevac Unit races against 'Golden Hour'. [Online] Available from: http://www.npr.org/templates /story/story.php? storyId = 6597623 Accessed on 3 October 2008.
13. Sefrin P. "Scoop and Run" Or "Stay and Play". The Internet Journal of Rescue and Disaster Medicine. 1998; 1: 1.
14. Haas B, Nathens AB. Pro/Con debate: Is the scoop and run approach the best approach to trauma services organizations? Critical Care 2008; 12: 224.
15. Parker PJ. Casualty evacuation timelines: an evidence-based review. J R Army Med Corps 2007; 153: 274-7.
16. Parker PJ. Damage control surgery and casualty evacuation: techniques for surgeons, lessons for military medical planners. J R Army Med Corps 2006; 152: 202-11.
17. Hough C, Sadler M, Patrician MA. Military nursing at the forefront: The Army Forward Surgical Team. Crit Care Nurs Clin North Am 2003; 15: 193-200.
18. Einav S, Schecter WP, Matot I, Horn JK, Hersch M, Reissman P, et al. Case managers in mass casualty incidents. Ann Surg 2009; 249: 496-501.
19. Wahl GM, Marr AB, Brevard SB, Weintraub SL, Hunt JP, McSwain NE, et al. The changing face of trauma: New Orleans before and after Hurricane Katrina. Am Surg 2009; 75: 284-6.
20. McLeod J, Hodgetts T, Mahoney P. Combat "category A" calls: evaluating the prehospital timelines in a military trauma system. J R Army Med Corps 2007; 153: 266-8.
21. Bricknell MCM. Organisation and design of Regular field hospitals. J R Army Med Corps 2001;**147**:161-167.
22. [Online] available from: http://www.celoxmedical.com accessed 11 July 2009.