

A survey of triage systems in combat casualty care for providing a revised system

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ABSTRACT

Purpose: Triage is a complicated and dynamic process in nature. Moreover, there are many challenges in selecting the required information about the casualties, the wounded, and the type of accident at the time of crisis. Hence, this research was undertaken to present a new strategy for efficiently triaging casualties in the battlefield.

Methodology: In this review, two methods of field and library research were used. The data were collected through related books and papers. Then interviews were done to validate the collected data.

Results: The analyses led to an operational, tactical model for triage, which is a step-by-step triage under enemy's attack and vital measures to rescue the wounded.

Conclusion: Learning and applying the three-step tactical combat casualty care will help the medics offer the right medical care at the right time to a larger number of the wounded within the battlefield.

Keywords: Triage; casualty care; tactical war; combat; care under fire.

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INTRODUCTION

Triage is a process for categorizing the wounded according to their need for rapid medical care. It is a dynamic, active method through which offering the medical care to the injured is prioritized. Triage was used in Napoleon wars for the first time in which the wounded received medical treatment at the battle field.¹

In the First World War, there was a major change in treating the wounded at the battlefield. For the first time, all of the wounded were moved to specified locations, classified according to their emergency needs, and were finally dispatched to different locations accordingly. However, during the Second World War, triage was done in a 3-step method. During the 8-year Iraq imposed war against Iran (September 1980 to August 1988), the triage was done based on the same traditional method which

is applicable to public areas or mostly appropriate for the natural disasters and catastrophes. This new method helped save many lives at that time.¹

Two million people suffer from natural disasters each year. Providing medical care for this number of victims is a very stressful task. Triage is more important in these critical situations. This can include hospital triage, disaster triage, or military triage depending on where it is performed.²

Emergency care has not been established in military battlefields same as the urban and academic environments. Thus considering the medical advancements and the new technologies, there is a large gap between urban/academic emergency care and tactical/military emergency care.¹ There are a number of complexities associated with triage and medical care in the battlefield

compared to those performed in natural disasters or incidents with high casualties. For example in a tactical environment, the medical personnel must work under the enemy fire.

So unlike natural disasters, there are difficulties in providing healthcare services and triage at the battlefield. While under enemy fire in a tactical environment, the medical personnel have to take care of the injured. In such a dangerous situation, all of the facilities and treatments should be prioritized. Similarly in military triage and triage in unexpected disasters, the goal is to provide the best medical services for as many wounded and casualties as possible. However, in military triage, the first priority is to return more soldiers to combat, while what matters in the non-military circumstances is to rescue more of the injured.²

During the triage, the type of treatment and the order which is provided do not matter. Still the tactical medics should focus on providing life saving services while providing the patients with triage. They should move from one patient to another quickly without spending much time on each patient, because in a battlefield, the threat of enemy's attack continue constantly at varying intensities.³

In 1996, a new system was developed to provide medical treatments in tactical fields. The system was called "tactical combat casualty care" (TCCC). Today, after a decade and with a number of published papers and found evidences, the system has been proven successful and is currently used for pre-hospital treatments of the

casualties. It is developing among the military forces and in civil tactical measures.⁴

In Iran, no national standard triage has been announced to the hospitals yet. Each hospital performs its own triage system. Moreover, no comprehensive, academic degree or certificate exists for teaching triage. These limitations may cause lack of appropriate actions and the shortage of knowledge about triage in the battlefield when necessary.⁵ Hence, this review sought to give an overview of triage systems and propose an applicable model for this country.

METHODOLOGY

In this study two methods of field and library research were used. For this review, 12 books and 28 articles in Persian and English published from 1987 until 2012 concerning civil and combat triage were studied. Seven of the books were in English and five in Farsi (**Table 1**). Also, 18 of the articles were in English and 10 in Farsi. In general, the literature was the main resource.

Afterwards, eight experts who had the experience of triage in the 8-year imposed war on Iran were interviewed. Six of them were from Iran's Army and two of them from Iran's revolutionary guards corps (IRGC). Five of the Army interviewees were from the ground forces and one from the Navy. Moreover, five of the Army interviewees were physicians and one was a nurse. The two IRGC interviewees were both nurses and from the ground forces. Their experience was used to validate the mentioned reviewed triage instructions which are explained in the following sections.

Table 1. The list of reviewed books and book chapters.

In English
Barash PG, Cullen BF, Stoeling RK. <i>Clinical Anesthesia</i> . 5 th ed. Philadelphia: Lippincott William and Wilkins; 2006.
Zajtchuk R, Rellamy RF, Grande CM, eds. <i>Textbook of military medicine: Anesthesia and perioperative care of the combat casualty</i> . Washington: TMM Publications; 1995: 1-42
Jamie R, Katbryn Z. Disaster Triage. In: Robert P, Elaine D. <i>International Disaster Nursing</i> . New York: Cambridge University; 2010: 57-80
Burris DG, Fitzharris JB, Holcomb JB, et al. Weapons effects and parachute injuries. In: Department of Defense. <i>Emergency war surgery</i> . 3rd edition. Washington DC: Skyhorse Publishing; 2004
Mcswain M, Frame S, Salomone J. <i>PHTLS basic and advanced prehospital trauma life support</i> . 5 th edition. Maryland: Mosby; 2003
Parrilo S. Medical care of mass gatherings. In: Hogan D, Burstein JL, eds. <i>Disaster Medicine</i> . Philadelphia, PA: Lippincott William & Wilkins; 2002
Schwartz R, McManus J, Orledge J. Tactical emergency medical support and urban search and rescue. In: Marx J, Hockberger R, Walls R, eds. <i>Rosen's emergency medicine concepts and clinical practice</i> . 6 th edition. Philadelphia: Mosby Elsevier; 2006
In Persian
Saghafinia M. Mabani triage: Olaviatdehi masdoomin dar havades [Triage basics: Prioritizing casualties in catastrophes]. Tehran: Helal-e-Iran Institute; 2012.
Afzalimoghadam M. Osule triage bimarestani [Principles of hospital triage]. Tehran: Teimourzadeh Publications; 2012
Karimi-Rahjerdi H. Moghadamei bar triage [An introduction to triage]. Tehran: Mehr-e-Amiralmomenin Publications; 2007
Sadaghiani E. Sazman vamoridriyate bimarestan [Hospital organization and management]. Tehran: Raha Publications; 2009
Hojat M. Modiriyate bohran va havadese gheire motaraghebe dar bimarestan [Catastrophe and disaster management in hospital]. Tehran: Boshra Publications; 2010

TRIAGE SYSTEMS

Simple Triage and Rapid Treatment (START)

This system was developed in 1983 and revised in 1994. The purpose of the START triage system was to find injuries which can result in death in an hour.⁶ The system investigated the status of breathing, blood circulation and consciousness level of the injured. However, there were some limitations. This triage system had been developed for common traumas. Thus, it was not efficient enough in natural disasters.⁷

Move, Assess, Sort and Send (MASS) Triage

The new system used a rapid classification which was developed according to the walking and order-performing ability of the injured and their categorization according to the standard military triage (immediate, delayed, minor and expectant). Being easily applicable, MASS quickly

helped triage and classified a number of casualties in a natural disaster without needing advanced skills and training in how to triage (**Figure 1**).⁸

The first step in MASS triage is “to move”. In this stage, those casualties who are able to walk are asked to move to a predetermined location. All of those who can walk to that location are considered patients with minor priority until the secondary examinations are done. The rest of the casualties are asked to respond to a simple command such as moving their organs. To carry out such commands, the patient must be conscious and have adequate blood circulation to the brain. Therefore, those wounded who are able to follow the commands are firstly considered as “delayed” wounded. The rest of the casualties will be classified in the immediate or expectant groups.⁹

“Evaluation” is the second stage in MASS triage. In

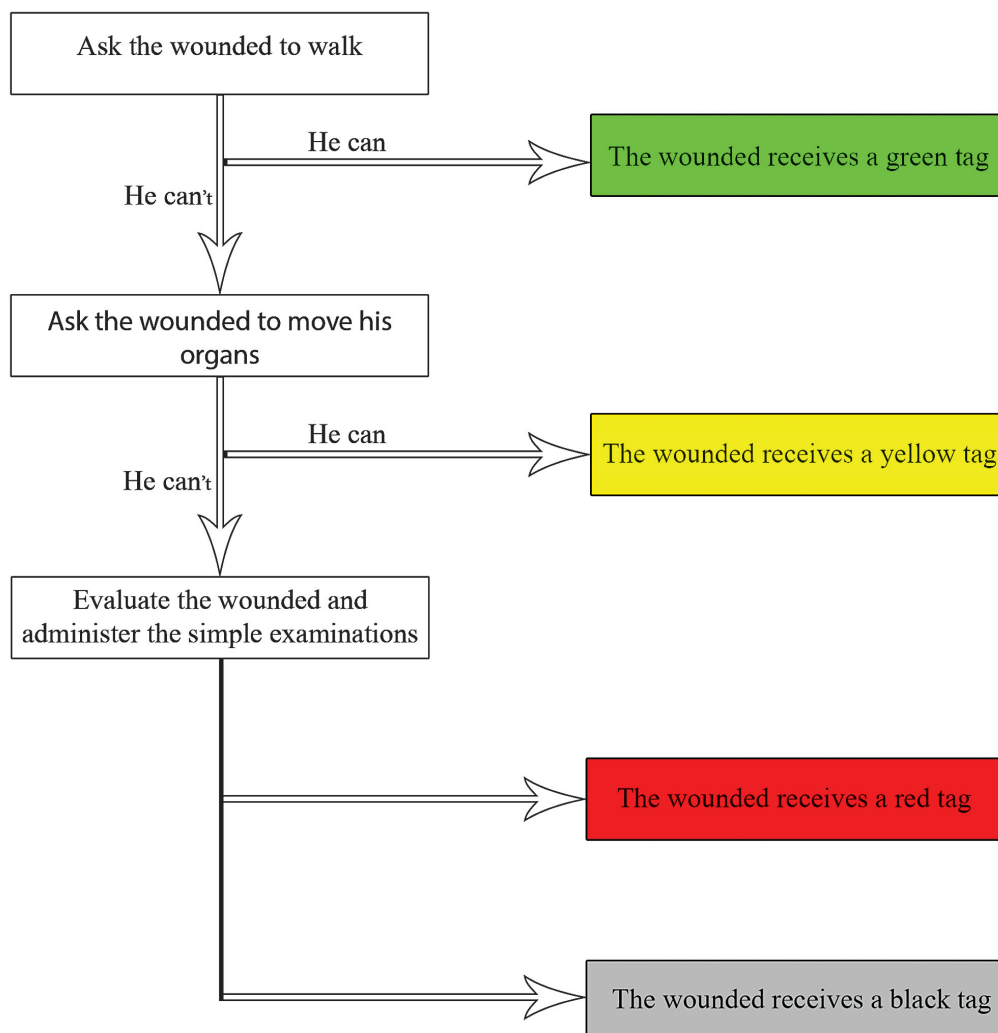


Figure 1. MASS Triage System

this stage, the wounded that cannot swing are evaluated and will receive life saving interventions. The basis for the evaluation stage in MASS system is the medic's ability in applying the clinical judgment in order to categorize the wounded correctly.¹⁰ The performed measures through the evaluation stage are only limited to the simple maneuvers including opening the airway and controlling the threatening blood loss. After evaluating the motionless wounded, the casualties who are categorized in minor and delayed groups are re-evaluated. In MASS system, the evaluation is as follows: evaluating the motionless patients, evaluating those who have subtle movements but are unable to walk and finally evaluating the wounded with walking ability.¹¹

In some groups, the medics are at the same time law enforcements or the militants. In such a situation, the priority must be to create a safe area during the combat. It is necessary that each team member perfectly does his/her primary duties during the war. The treatment of wounded should be postponed until they are transported to a warm or cold zone (i.e. somewhere in which there little or no threat of enemy). After transporting them to a safe place, the patient should be evaluated and if needed, the life saving interventions should be applied.¹²

The specific conditions of the tactical field necessitate specific triage and algorithm. Using a standard triage system, specific to the tactical environment, the medics will be able to provide the right treatment in the shortest time possible. Using simple physiological labels for the wounded will help the medics provide better triage.¹³

Tactical Triage

Tactical triage system will enable the tactical emergency medical support (TEMS) members to determine the level of emergency treatment and the evacuation priority by predicting the probability of rescuing a wounded or need of an injured for the life saving interventions. Using a standard triage system and the physiological labels will help in this process¹⁴.

This triage system which can be used in tactical environments has been presented in **Figure 2**. The purpose of this algorithm is to find the injured that need the life saving interventions. Like other triage systems, the wounded will be transported to one of the minor, delayed, immediate, and expectant groups.¹⁵

a) The Minor Group (Green):

Most wounded in this group are able to walk. They suffer from subtle injuries (burns, small raptures and lacerations and minor fractures) and can take care of

themselves. The life saving interventions can be delayed for 4 to 6 hours in these cases. They can still be helpful in the advancement of the operations (such as the security of the battlefield).

b) The Delayed Group (Yellow):

These casualties need medical measures such as operations, but their general condition allows us to postpone the life saving interventions and the operations without endangering their survival chance. Despite that, supportive and primary treatments on them (such as enteral or intravenous feeding, splinting, injecting antibiotics and pain control) will be necessary. Some of the injuries of this group include: being injured but not in shock, having large soft-tissue injuries, fractures of the main bones, thoraco-abdominal injuries, and less than 30% of body burns when there is no threat to the airways.

c) The Immediate Group (Red):

This group includes the wounded that are in the urgent need for operation and life saving interventions. No rapid action in less than 5 minutes will result in their death. The injuries of this group are as follows: unstable homodynamic condition with respiratory obstruction, thoraco-abdominal injuries, huge external bleeding and shock. These casualties may be unconscious and suffer from weak radial pulse.

d) The Expectant Group (Black):

The patients in this group are those with so severe injuries that their chance of survival is very low, regardless of receiving all the treatments and facilities available. However, they should not be neglected. If possible, they should receive palliative care and painkillers to ease them.

It is obligatory for the medics to consider that triage is not a still process but a dynamic procedure. Over time, with changes in the status of the patients, it is necessary to repeat and re-categorize the patients.¹⁶

PRINCIPLES OF MILITARY TRIAGE

Since in a tactical environment the medic has access to few facilities to decide on triage, the right treatment and on-time evacuation of the injured depend on the availability of tools which can be easily used in triage. The main purpose of a triage tool is to carry the wounded to the proper facilities at the right time.¹⁷ As mentioned earlier, in order to specify the priorities, most of the triage tools use physiologic labels. The reason why these tags are used in triage is that they are easily measurable and transfer the general information about the patient's condition to

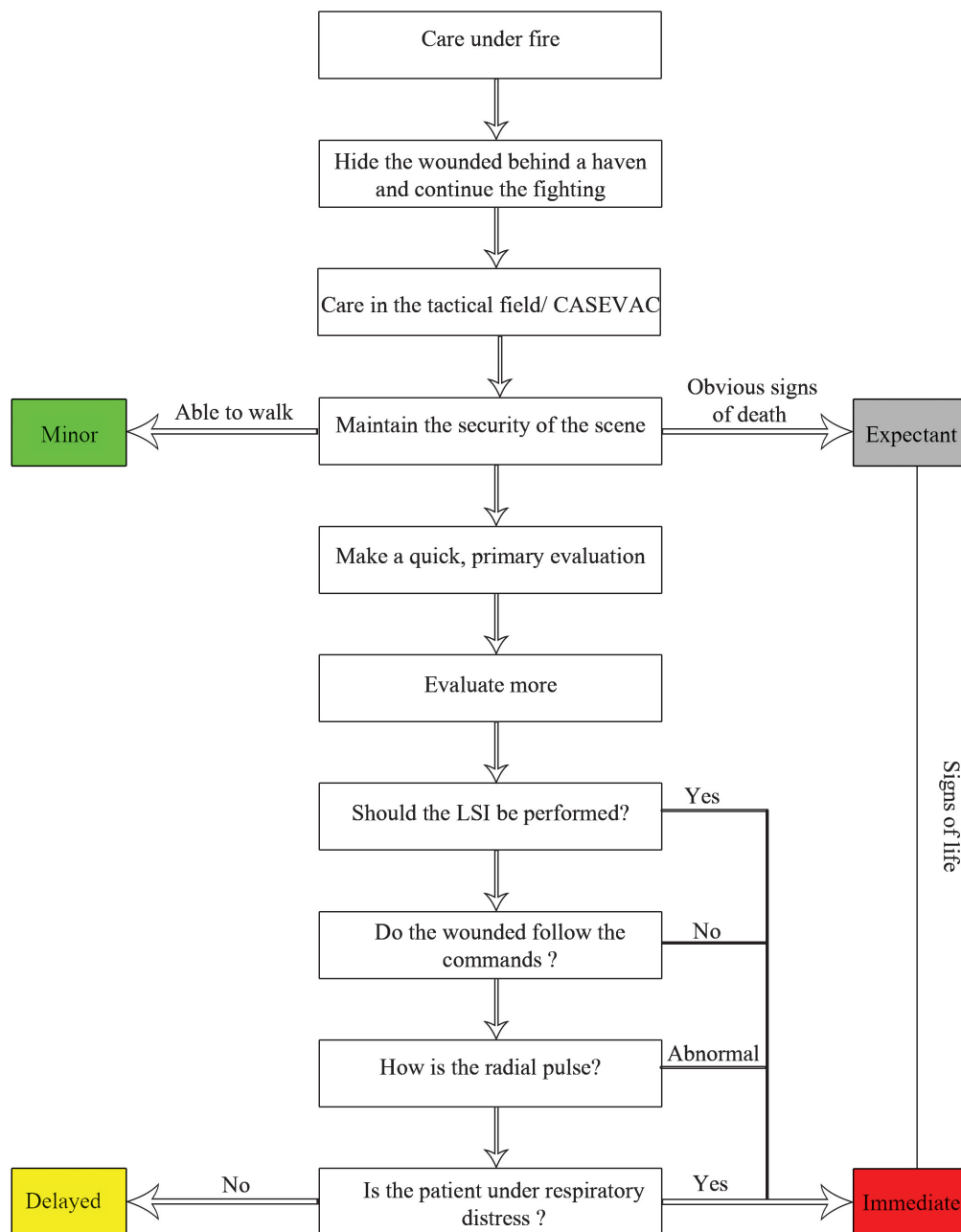


Figure 2. Tactical Triage System

the medic. Nonetheless, not all the physiological tags are directly related to the patient's prognosis (such as the respiratory rate or the oxygen concentration). In addition, not all of the physiological labels are measurable. As an example, manually measuring the blood pressure or checking the respiration rate of the injured are impossible in some tactical environments.¹⁸

The pre-hospital care in tactical fields is provided in three steps: care under fire, tactical field care, and combat casualty evacuation care. This division is done

for the medics to learn about their responsibilities and duties at each step and be able to do their best at the shortest time possible.¹⁹ This model of triage is called tactical combat casualty care.

TACTICAL COMBAT CASUALTY CARE (TCCC)

a. Care under fire

This means treating the injured while both the injured and the medic are under direct enemy fire. This region is

the hot zone, meaning that the possibility of more harm to the injured and to the medic is serious. Thus, there are few medical facilities and little chance to provide the medical services. During this stage, there is no time and space to open the medical bag and look for the necessary tools.

- Instructions for care under Fire

- a-1) Respond to enemy fire and take shelter.
- a-2) Ask the wounded to respond to enemy fire if he/she is still able to do so.
- a-3) Help the wounded to take a shelter.
- a-4) Try to avoid further injuries to the wounded.
- a-5) Keep the wounded away from vehicles or buildings that are on fire, and move him/her to a relatively safe location.
- a-6) Try to delay controlling the patient's airways for the care in a tactical environment.
- a-7) Stop severe external bleedings if the tactical situation is suitable.
 - Instruct the wounded to control his/her bleeding if he/she is able to do so.
 - Use an appropriate tactical tourniquet to stop the bleeding (if applicable, depending on the type of injury).
 - Fasten the tourniquet tightly above the cut and on the cloth. Then, move the wounded behind a suitable cover.

b. Care in tactical field:

It is the care provided in an operational field, but not under the direct enemy fire. Here, the medic's ability in care-giving is limited due to the existing situation and limited resources.

- Instructions for care in tactical field

- b-1) Disarm the wounded who has decreasing consciousness immediately.
- b-2) Control the airways.
 - b-2-1) For wounded with decreasing consciousness without airway obstruction:
 - b-2-1-1) Perform the jaw-thrust maneuver.
 - b-2-1-2) Create a nasopharyngeal airway for the patient.
 - b-2-1-3) Place the wounded in the recovery position.
 - b-2-2) For wounded with an obstructed airways or with the airways that are being obstructed
 - b-2-2-1) Perform the jaw-thrust maneuver.
 - b-2-2-2) Create a nasopharyngeal airway for the patient.

- b-2-2-3) Let the patient place him/herself in the most comfortable position to maintain his/her airway open.

- b-2-2-4) Place the wounded with decreasing consciousness in the recovery position.

- b-2-2-5) In case all the previous attempts are unsuccessful, operate the surgical cricothyroidotomy (apply lidocaine if the patient is conscious).

- b-3) Control the respiration

- b-3-1) the patient with developing respiratory distress and torso trauma suffers from tension pneumothorax, unless otherwise proved. In this case, insert a 3.5-inch long, 14 cutter or needle through the second intercostal space in the mid-clavicular line in the chest. Make sure the needle has entered through the external side of the nipple with no harm to the heart.

- b-3-2) All the open and suction wounds in the chest must be immediately covered by a gauze or any other suitable cover. Check the patient for tension pneumothorax.

- b-4) Control the bleeding

- b-4-1) Precisely check any possible source of bleeding that may have remained unknown to you so far. If there is any, control all of them, applying a tactical tourniquet and securing it at the 2-3 inches above the wound.

- b-4-2) If tourniquet cannot be used due to the position of the wound, or if it should be replaced (when the time for evacuation is more than 2 hours), combat gauze can be applied as a blood coagulator. Combat gauze must be pressed for 3 minutes on the wound. Before releasing the tourniquet for those wounded who are resuscitated by the bleeding shock, make sure they have responded to resuscitation successfully (the normal quality of field pulses and proper consciousness in case of no brain injury).

- b-4-3) Check if the patient's previous injury needs a new tourniquet. If a tourniquet is still needed to stop bleeding, remove the current tourniquet from the patient's clothes and place it directly on the skin, 2-3 inches above the wound. If it is not needed anymore, apply other techniques to control the bleeding.

- b-4-4) If there is no threat regarding the time and the tactical conditions, control the distal pulse of the wounded area. If the pulse is still felt, tighten the tourniquet or apply a secondary tourniquet

- beside and above the primary tourniquet so that the distal pulse is not felt any more.
- b-4-5) Using a visible tag, specify all the tourniquets and the time span they were used.
- b-5) Find intravenous access
- b-5-1) Find patient's blood vessel using an 18-gauge cutter and saline lock (if needed)
- b-5-2) If the patient needs resuscitation but you were unable to find his/her veins, use intraosseous (io) infusion.
- b-6) Fluid resuscitation
- b-6-1) Examine if the patient had a hemorrhagic shock. The best symptoms to detect shocks are decreasing consciousness (in case of no brain injury) and lack of field pulses.
- b-6-1-1) If the patient is not in shock, there is no need for intravenous fluid injections
- b-6-1-2) If the patient is conscious, fluids can be given orally
- b-6-2) If the patient is in shock:
- b-6-2-1) Inject the 500 cc Hextend intravenous (iv) fluid in one shot.
- b-6-2-2) After 30 minutes, inject 500 cc more if the patient is still in shock.
- b-6-2-3) No more than 1000 cc Hextend iv fluid should be injected.
- b-6-3) If resuscitation needs to be continued, you should consider the available facilities, tactical situation and the possibility of new injuries.
- b-6-4) In case of brain injury, if the patient is not conscious and has no field pulse, continue the resuscitation until the radial pulse is back.
- b-7) Preventing decrease in body temperature (hypothermia)
- b-7-1) Minimize patient's direct contact with the external environment.
- b-7-2) Change the wounded's wet clothes with dry ones.
- b-7-3) Cover him/her with special warming blankets (such as: Blizzard Survival blanket, Ready Heat blanket).
- b-7-4) If available, cover his/her head with thermo-lite hypothermia prevention system. cap by placing it between the helmet and the head.
- b-7-5) If needed and available, use more facilities.
- b-7-6) If the above-mentioned facilities are unavailable, use dry blankets, sleeping bags, and whatever possible to keep the patient dry and warm.
- b-8) If any eye-penetrating injury or risk of this injury exists
- b-8-1) Quickly check the vision level.
- b-8-2) Cover the injured eye, using an eye shield.
- b-8-3) Give the patient a fluoroquinolone antibiotic, for example moxifloxacin, 400mg. If he/she is not able to take the medicine orally, use an intramuscular (im) method.
- b-9) A pulse oximeter must be available to monitor the wounded. In case of severe hypothermia or shock, the likelihood of errors in pulse oximetry is high.
- b-10) Double-check and re-dress the injuries.
- b-11) Re-examine other unattended injuries.
- b-12) If necessary, apply anesthetics.
- b-12-1) If the injured is able to continue fighting
- b-12-1-1) Meloxicam tablets, 150 mg, orally, daily
- b-12-1-2) Acetaminophen tablets, 500 mg, orally, every 8 hours
- All the soldiers should always have such medicines with them and use whenever necessary.
- b-12-2) If the injured is not able to fight
- b-12-2-1) When there is no need to find patient's blood vessel:
- Use inside-the-cheek form of Fentanyl, 800 mg:
 - Re-examine the patient after 15 minutes.
 - If the pain still exists, place another Fentanyl tablet at the other side of the patient's mouth.
 - Check his breathing.
- b-12-2-2) If the blood vessel is already found:
- Morphine Sulfate Ampoule, 5 mg, iv
 - Re-examine the patient after 10 minutes.
 - If the pain still exists, redo the injection every 10 minutes.
 - Check the patient's breathing.
 - To prevent nausea and to extend the numbness, use Promethazine, 15 mg, IO/IM/IV, every 6 hours.
- b-13) Splint the fractures and then check the organ pulses.
- b-14) Using antibiotics is recommended in all open wounds.
- b-14-1) If the patient is able to take the medicine orally:
- b-14-1-1) Moxifloxacin, 400 mg orally daily.
- b-14-2) If the patient is unable to take the medicine orally (being unconscious or in shock):
- b-14-2-1) Cefotetan, 2 g, iv (slow injection in 2-3 minutes) or im every 12 hours.

b-14-2-2) Ertapenem, im/iv, 1 g, daily.

b-15) For burns:

b-15-1) Facial burns, especially those happening in closed areas, may hurt respiratory tracts. In these cases, take serious care of the air ways and blood oxygen. If either the respiratory distress or decrease in oxygen saturation happens, rapidly make an airway for operation.

b-15-2) Rapidly estimate the percentage of the severity of burns according to the total body surface area, following the rule of nines.

b-15-3) Cover the burns with dry and sterile dressings. In larger burns (> 20%), cover the patient in special blankets for hypothermia prevention (like blizzard survival blankets) in order to cover the burns and prevent temperature decrease.

b-15-4) For fluid resuscitation in burns

b-15-4-1) If the burn is greater than 20% of the total body surface area, the fluid prescription should start immediately after obtaining blood vessels. To resuscitate, inject lactated ringer's solution, normal saline, or Hextend iv fluid. If using Hextend iv fluid, no more than 1000 mL should be injected. If more fluid is needed, you can use lactated ringer's solution or normal saline.

b-15-4-2) The intravenous fluid injection rate is calculated as percentage of total body surface area $\times$ 10 mL/hr for adults weighing 40-80 kg.

b-15-4-3) In weights above 80 kg, increase the initial rate by 100 mL/hr per every 10 kg above 80 kg.

b-15-4-4) If hemorrhagic shock also exists, the shock treatment is a priority over burn. In these patients, the fluid treatment should be done according to Section 6.

b-15-5) To control burn pains, administer according to section b-12.

b-15-6) Burns, by themselves, do not need antibiotics therapy in tactical fields. However, if you need to prescribe antibiotics to prevent infections in penetrating wounds, perform it according to Section b-14.

b-15-7) All the above interventions can be done on burned skin surfaces in burn casualties.

b-16) If possible, communicate with the wounded.

b-16-1) Reassure them.

b-16-2) Explain to them how and what type of treatment is being used.

b-17) For the wounded suffering from blast or

penetrating trauma, without any pulse or respiration, and no other life signs, the cardiopulmonary resuscitation will not be successful in the operational field and should not be administered.

b-18) Record all of the clinical assessments, provided treatments and changes in the injured status on a TCCC casualty card. Transfer this card with the wounded to the next care level.²⁰

C) Casualty evacuation care

The treatment provided, while evacuating the patients from a combat zone, is called casualty evacuation care. The casualties can be transported through the air, land, or sea. Although more facilities and personnel are available in this stage, there are also some special constraints (such as limited space, mobile field, etc.). Here, two terms are of importance: casualty evacuation care and medical evacuation. Casualty evacuation care is the treatment rendered by the military transportation vehicles while transferring the casualty. However, medical evacuation is the casualty evacuation by a medical vehicle such as an ambulance or air ambulance.²¹ It should be noted that all of the care instructions in the tactical field are applicable in the casualty evacuation stage.

TRIAGE: A MODERN NECESSITY

The life-saving interventions in a triage are:

- Opening the airway by placing the wounded in an appropriate position (advanced airway tools should not be used).
- Controlling the general bleeding by applying tourniquets or direct pressure.
- Treating a tension pneumothorax using a needle.

A casualty cannot be considered a high mass-casualty incident because of the number of the wounded, since the number of the casualty increases not because of the number of wounded, but the system constraints. In some systems, due to the resource limitations, the existence of four casualties can result in a mass-casualty incident. However, in other systems, the presence of 10-15 injured may not cause any conflict. In a mass-casualty incident, the extra forces can be used to improve the system capacity. The priority in the mass-casualty incidents is given to providing medical services to the wounded with more serious conditions.

After a natural catastrophe, the system's capacities and the personnel are often incapable of meeting the needs of the wounded. The concept of triage can change because of these limitations. In such a situation, the priority is

not providing healthcare to the most seriously injured but providing services to the largest number of them. Performing so will be very difficult for the medics, as human beings naturally tend to help patients with most serious conditions. The primary goal in triage in natural catastrophes is to find the wounded with less urgent medical care (Green group) and the wounded that will have little chance of survival even after receiving medical care (Black group). After identifying these groups, the resources and facilities should be dedicated to the other patients, namely, wounded with medium (Yellow group) to serious (Red group) injuries. It should be noted that:

1. Triage is not treatment. Although we may apply the life-saving interventions, triage only means to prioritize the care and evacuation.
2. Triage is a dynamic process.
3. One should decide which triage system fits his/her organization best.
4. Advanced trauma life support cannot be provided in tactical fields. It is specifically designed for hospital environments.
5. Rapid control of bleeding, creating airways and removing respiratory difficulties can reduce the death rate in the operation zones.

CONCLUSION

The tactical medics must be familiar with the TCCC principles. Being able to apply TCCC's three steps will help the medics render the right medical care at the right time to the largest possible number of patients in the battle field.

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