The implementation of TCCC medical supplies in medical rescue teams

(Implementacja środków medycznych TCCC w zespołach ratownictwa medycznego)

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Abstract – The authors have discussed the differences between medical and tactical rescue, focusing on medical supplies used in the TCCC standard and in medical rescue teams.

Key words **-** medical supplies, TCCC, medical rescue

Streszczenie – Autorzy omówili różnice pomiędzy ratownictwem medycznym a ratownictwem taktycznym, zwrócili uwagę na środki medyczne wykorzystywane w standardzie TCCC oraz w zespołach ratownictwa medycznego

Słowa kluczowe **-** środki medyczne, TCCC, ratownictwo medyczne

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I. DIFFERENCES BETWEEN TACTICAL AND MEDICAL RESCUE

Medical aid in a tactical environment is related to a permanent state of danger. TCCC procedures are often performed behind a cover, with a direct threat of enemy opening fire. Enemy fire, a strict light and sound discipline, extreme weather conditions, poorer equipment adjusted to combat reality, longer waiting period before transport to hospital, variety of traumas, and different preparatory training are only a handful of differences between rescue medicine in combat and in peace.

Having analysed the statistics pertaining to deaths on battlefields, the main causes of soldiers' deaths might be characterised. They include [2]:

- Penetrating head traumas – 35%,
- Vast inoperable body injuries – 29%,
- Potentially treatable body injuries – 11%,
- Massive extremity haemorrhages – 10%,
- Post-explosion traumas – 8%,
- Tension pneumothorax – 6%,
- Airway obstruction – 1%.

It is also worthwhile to compare these data with the information of the most frequent causes of the so-called *preventable deaths*. They include:

- Massive haemorrhages from arms and legs – 60%,

- Chest traumas (especially pressure-related), also those with tension pneumothorax with z hypertension – 33%,
- Airway obstruction – 6%.

According to the data of Trauma Registry for civilian environment, around 61% deaths occur within the first minutes after the injury. For combat environment, it is 66%. Heavy and lethal wounds do not leave the casualties with large chances for survival. They include [18]:

- Traumas to central nervous system (CNS) – 61%,
- Massive haemorrhages – 18%,
- Obstructed airways, ventilation disorders – 8%,
- Multi-organ failure – 13%.

The analysis of the causes of death both on battlefields and in civilian reality indicates there are differences between the injuries sustained in both these contexts. As a result of that, the acronym of CBA (Table 2) was created for the purposes of tactical combat environment from the inversion of the civilian rescue acronym ABC: Airway, Breathing, Circulation. The intentional reversal of the rescue proceedings is aimed at addressing the causes of preventable deaths. The letter C, instead of Circulation (according to European Resuscitation Council) or Chest Compressions (according to the American Heart Association standard) stands for Control Bleeding First [12,17].

Table 2. Differences between tactical medicine and street EMS [2]

No.	TCCC (CUF)	Street EMS
1	Fight and repel the enemy. Disarm the casualty	A – airway patency, stabilise the spine
2	Stop haemorrhages	B – breathing
3	Breathing and ventilation – if required, unblock the airways and consider relieving the tension pneumothorax	C – circulation
4	Consciousness state	D – consciousness state
5	Exposure – as much as the environment allows	E – exposure, removing all clothing

The CBA algorithm is realized mainly by medics and casualties themselves as self-aid according to the Prehospital Trauma Life Support (PHTLS) and American College of Surgeons standards: each blood cell matters [19].

II. MEDICAL SUPPLIES USED IN THE TCCC STANDARD AND MEDICAL RESCUE TEAMS

Massive loss of blood is one of the most common causes of battlefield deaths. The main factor to cause the bleeding is an injury to arms and legs. This is so because limbs are more exposed than other parts of the body, which are protected by the modern equipment, such as ballistic vests and a Kevlar helmets. The primary aid provided in cases of such bleeding is to apply direct pressure and a tourniquet. This constitutes a crucial first aid action in tactical combat when extremity haemorrhage occurs [20]. There are two kinds of tourniquets that are currently approved and recommended by the Committee on Tactical Combat Casualty Care (CoTCCC): Combat Application Tourniquet (CAT) and Special Operation Forces Tactical Tourniquet – Wide (SOFTT-W).

According to the guidelines of TCCC, a tourniquet should be placed depending on the phase [4]:

- In the Care Under Fire phase, tourniquets should be applied over the uniform, as high up the arm or thigh as possible, by the soldier himself or by the rescuer. Afterwards, the time of the application should be put down either on the tourniquet (CAT) or on a visible spot on the casualty's body (forehead, cheek) with a letter T for tourniquet.
- In the Tactical Field Care phase (in hiding, under cover), tourniquets should be applied directly on skin using an individual Olaes or Blast type dressing. If the haemorrhage is a major one and a tourniquet and a dressing will not do, haemostatic medicines should be considered (e.g. Celox Gauze).
- If putting on one tourniquet does not stop bleeding, its tightness should be checked or another tourniquet should be placed.

If the evacuation is taking longer than expected, the loosening of the tourniquet should be considered after two hours (as long as an individual Olaes dressing was applied correctly before). Also, the rescuer has to check whether the individual dressing and raising that limb would be enough to stop the bleeding. Tourniquets can only be loosened if the casualty presents a correct haemodynamic reac-

tion to the fluids applied, i.e. the pulse is normalised and the casualty is more conscious, as long as there is no head injury [20]. A relevant element for ensuring a local haemostasis is the application of haemostatic supplies that are largely helpful for stopping haemorrhages or stop them altogether. The solutions applied currently are based on gauze soaked with a haemostatic medicine, also in the form of granules. Physical specifications of these products enable the medication to be applied directly on the wound and to apply pressure for 3 to 5 minutes, depending on the manufacturer's advice. Haemostatic supplies come in sterile, waterproof packages. Some of the available solutions work effectively regardless of the blood clotting factors (heparinised blood) and in hypothermia conditions.

CoTCCC recommends the application of haemostatic medical supplies to stop external bleeding in the TFC phase. The Committee's primary recommendation is QuikClot® Combat Gauze. The active substance of this product is kaolin (a neutral aluminium silicate volcanic mineral). It triggers no unfavourable exothermic reactions that would cause tissue burns. The effect produced by kaolin is based on the activation of the internal clotting cascade. By absorbing water from the environment, kaolin activates factor XII (Hageman factor), influencing the aggregation of platelets and facilitating the formation of fibrin [20]. The effective time of Combat Gauze application is up to 5 minutes, which is why it should be reserved specifically for the safe conditions in a tactical environment [21].

Another haemostatic product used in the battlefield medicine is Celox. This product, based on chitosan (obtained from the exoskeleton of sea crustaceans) and derived from polysaccharides, is used in the form of granules. The effect Celox produces is the formation of a pseudo-clot caused by the activity of electric charges between the substance and red blood cells, as a result of which a gel dressing is formed. Different variations are available on the market, including Celox D – in the form of granules, Celox A – a dispenser with granules for penetrating wounds, Celox Gauze – a gauze soaked with the active substance [20].
Haemostatic dressings are an integral component of the Individual PMed Pack carried by Polish soldiers.

Another product that has a haemorrhage-stopping effects is tranexamic acid (TXA, Exacyl®). TXA is a synthetic amino acid with anti-haemorrhagic properties. Its effects consist in stopping plasma plasminogen activators directly and single-stage inhibition of tissue plasminogen activators. The result of this is stopping the transition of plasminogen into plasmin. Exacyl is a poor inhibitor of plasmin. As a free amino acid, it does not bind with plasma proteins and it penetrates tissues rapidly. It can get through the blood-brain barrier and reach the synovial fluid. It is removed from the organism within 12 hours in a state 90% unchanged by the kidneys with its anti-fibrinolytic activity retained. The application of 1 gram of TXA in 100 millilitres of 0.9% NaCL or Ringer's solution within three hours after the trauma is recommended. The drug is permitted for use only in medical facilities and during special operations per the directive of the Republic of Poland Defence Department Under-Secretary of Health, 4 Nov. 2011 [22].

Thanks to real combat activity in Iraq and Afghanistan, efficient organisation of medical supplies and field hospital treatment, knowledge and involvement medical personnel, military healthcare professionals gain vast experience. Battlefield does also have impact on medical procedures in civilian reality. It is important to introduce tactical rescue principles into standard medial rescue, especially as far as stopping haemorrhages, dressing gunshot wounds, and treating multi-organ injuries is concerned. The aforementioned medical supplies are used on a day-to-day basis on battlefields do find their way in ordinary medical rescue practice. CAT tourniquets are a part of PSP R1 rescue kits. A recognised product for stopping external haemorrhages called Emergency bandage (a.k.a. Israeli emergency bandage, Israeli bandage) has been successfully used in Helicopter Emergency Medical Services (HEMS). Haemostatic dressings are effective in cases of blood clotting disorders. Exacyl is used on everyday basis in Hospital Emergency Rooms. Equipment used for fast transfusions and USG applied to multi-organ traumas are utilised much more frequently.

III. SUMMARY

The awareness of the progress made in the field of tactical combat medicine increases the chances to save those who have been wounded in battles. The military experience gained in overseas missions make it possible to develop a scientific approach to the implementation of medical and logistical procedures and schemes. This constitutes a perfect tool to minimise human resource losses during the realised combat objectives. Deaths are inevitable in modern-day military activities, but an effort can be made to minimise their number by proper care over the wounded in tactical combat environment, i.e. implementing the Tactical Combat Casualty Care (TCCC, TC3) procedures. The basic assumptions of TCCC are to prevent death, if it can be prevented, to avoid any further casualties, and to perform the task. It is estimated that during combat, the most common cause of the so-called preventable deaths are: massive extremity haemorrhages (60%), tension-related injuries to the

chest, especially tension pneumothorax (33%), and obstruction of upper airways (6%). The implementation of different procedures than those performed in civilian environment is motivated mainly by the mechanism of the injury to a soldier or a functionary. In tactical combat conditions, the medical intervention should performed correctly and in correct time, so that the wounded can come back to their tasks as fast as it is possible, if it is indeed possible. It has to be remembered that a casualty may expect aid under enemy fire, which places the rescuers in a position in which they have to operate under enemy fire. The medical aid in TCCC standard is about acknowledging the fine line between safety and danger. The division into three zones of operation in tactical environment provides guidelines on the operations which should be applied to casualties. Sudden changes of the situation into worse may trigger conditions in which part of the procedures is infeasible or inadvisable.

Thanks to working in the combat environment, efficient organization of medical supplies and field hospital workload, and knowledge and involvement of medical personnel, military healthcare professionals gain new, vast experience. Battlefield does also have impact on medical procedures in civilian reality. It is important to introduce tactical rescue principles into standard medial rescue, especially as far as stopping haemorrhages, dressing gunshot wounds, and treating multi-organ injuries is concerned.

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