

Tactical Combat Casualty Care: problem outline, application, rules of proceeding

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Summary:

Tactical Combat Casualty Care (TCCC) is strictly connected with battlefield medicine and assault tactics. It covers a broad scope of procedures, techniques and combined actions aimed at providing effective aid to one's own casualties at the time of military operations and their evacuation from the field of battle. The paper presents the rules of proceeding and the range of actions taken under TCCC.

Key words: Combat Casualty Care, TCCC, application, rules of proceeding.

Ninety per cent of casualties during military operations die before they are provided medical aid [1,2]. This fact is the main reason for the ongoing introduction of improvements in casualty care in the field of battle. The answer to this problem is Tactical Combat Casualty Care (TCCC) whose aim is to treat potentially reversible causes of cardiac arrest during combat, along with providing tactical security of the site [4,5]. Studies on the topic indicate that among the most common causes of death in the field of battle are limb haemorrhages (60%), respiratory problems (33%) and obturation of respiratory ways (13%), therefore all actions under TCCC are aimed at coping with the above life-threatening conditions [4,1,2,6,3,7]. Actions introduced according to the TCCC algorithm are meant to keep the subject alive until the final treatment is available and encompass pre-hospital procedures, such as application of tourniquet to manage massive limb haemorrhages, needle decompression in the cases of tension pneumothorax, and tracheotomy in the cases of impaired air flow

through respiratory ways due to facial trauma [4,5,8,9,10,11,12,13,3,7].

TCCC: attempted definition and rules of proceeding

There are many incorrect interpretations and abuses of the term Tactical Combat Casualty Care, thus it is crucial to identify the actions it covers. TCCC may be defined as a component of special tactics realized by military units, subunits and other tactical groups. This type of tactics is strictly connected with battlefield medicine and assault tactics. It covers a broad scope of procedures, techniques and combined actions aimed at providing effective aid to one's own casualties at the time of military operations and their evacuation from the field of battle. Its main goal is to save the lives of casualties through relocation (in search of a short-term shelter from danger), counterattack and providing first aid. The main principles of Tactical Combat Casualty Care are gathered in the TCCC guidelines [2,11,12,3].

Noteworthy is the fact that one of the most significant features of TCCC is a changed nature of life saver's actions and procedures, which are different to those in civilian environment. According to the TCCC procedures, the first casualties to be provided with aid are those less severely wounded, so that they may return as quickly as possible to the military operation and support their unit. Life saver's own safety is a very important aspect. TCCC concerns a given unit or subunit in a hazardous location which is forced to use its own means to provide first aid to its wounded members [2,11,12,3].

TCCC: zones of care

Considering the level of threat posed by the enemy, TCCC distinguishes three zones: hot (also known as ground zero or hot spot), warm (relatively safe) and cool (safe) [14].

The hot zone refers to a location occupied by enemy forces, in which constant risk to health and life occurs. Actions taken in that zone are named Care Under Fire, since they are executed under direct enemy gunfire and involve counteractions leading to stopping the enemy attack, relocating the casualty to a covered site and treating any external haemorrhages using a tourniquet or haemostatic bandage [2,11,12,3,7].

The warm zone is in close proximity to the hot zone and enemy actions may still reach people in that zone. The warm zone is also called the Tactical Field Care zone. It is usually located at the back of the main operation zone. Most actions taken under TCCC are performed there, such as preliminary casualty segregation and first aid. Other unit members who do not participate in providing aid are in combat readiness. The first casualties to be provided with aid are those with the least severe wounds and the greatest chance of survival, so that they may return as quickly as possible to their duties and support their unit in the military operation. Once treated, the wounded need to be moved away from that zone to a safe place, as the warm zone may become a hot zone at any time. At this stage, the CABDE examination is also performed, i.e. the assessment of circulatory functions, air flow through the respiratory tract, respiratory functions, neurological state and entire body examination for possible traumas [3,7].

The third and last zone distinguished by TCCC is the cool zone. It is an area in which no threat from the enemy is present, while it is possible to pass the casualties to civilian paramedics. It is indicated that a field hospital be located in that zone. Medical aid is provided to all casualties, particularly those most severely wounded. Action taken at this stage are named Tactical Evacuation and cover evacuation both from the field of battle (Casualty Evacuation, CASEVAC) and medical evacuation conducted by air from the site where the wounded may be taken to a field hospital (Medical Evacuation, MEDEVAC) [11,12].

Actions taken under TCCC

Providing Care Under Fire is based on stopping the enemy attack, protecting one's own safety and relocation along with the casualty to a covered site where all life-threatening external haemorrhages may be stopped using a tourniquet over the uniform in limb haemorrhage cases or compression/haemostatic bandage for wounds in other body parts. Clearing the respiratory tract is best postponed until relocation into a relatively safe place. It is vital to talk to the wounded, reassure them and explain the actions involved in the first aid [2,11,12,3,7].

When providing Tactical Field Care to unconscious casualties, their respiratory tract should be cleared either manually using the head-tilt/chin-lift manoeuvre or a nasopharyngeal tube, and if the above methods fail, performing tracheotomy is suggested [14,11,12,3,7]. In order to assure clear airways the wounded should be placed in the recovery position. Casualties with altered state of consciousness should be disarmed immediately, as they may pose danger. In subjects with penetrating traumas cervical immobilization is not required [6,11,12,3,7], while it should be considered in the victims of mine explosions [5,15]. Casualties with chest trauma and breathing difficulties are to be suspected of tension pneumothorax. It is indicated to relieve tension pneumothorax by puncturing the damaged chest using a 14-gauge needle. Puncture site should be located in the 2nd intercostal space in the midclavicular line [4,11,12,3,7]. Open or sucking chest wounds should be dressed with a tight bandage [11,12]. The casualty should then be observed for possible development of tension pneumothorax [11,12,3,7]. At this stage, previously applied

bandages are checked and previously unidentified haemorrhages are sought and secured with bandages. Additionally, the possibility of removing tourniquets is assessed once the wound is dressed using compression or haemostatic bandages. If it has not been done before, massive haemorrhages from extremities are blocked with tourniquets applied directly onto the skin, 5–8 centimetres above the wound [9,11,12]. If, despite tourniquet application, pulse is present in the distal parts of the limb, tightening the tourniquet or applying another one above should be considered [8,9,11,12,13,3,7]. Haemostatic bandages are applied over haemorrhages from other body parts [11,12,3,7]. If needed, an 18-gauge intravenous line or, when that is not feasible, intramedullary line should be applied [11,12,14,15]. In casualties presenting signs of hypovolaemic shock, such as altered state of consciousness with no recent head injury and faint or absent peripheral pulse, it is recommended to administer 500 ml Hextend I.V. (6% HES with physiological crystalloid other than 0.9% NaCl as carrier). If no improvement is evidenced after 30 minutes, the dose may be repeated once. In conscious casualties with no signs of shock liquids may be administered orally [11,12,3,7]. In subjects requiring blood transfusion administration of tranexamic acid (TXA, AXACYL) is recommended to decelerate fibrinolysis by inhibiting plasminogen activation to plasmin. The subject is administered I.V. 1 g TXA dissolved in 100 ml 0.9% NaCl or lactated Ringer's solution.

Another dose is administered after Hextend or other infusion [12]. The decision to continue resuscitation should be made taking into account the logistic and tactical conditions, as well as the risk of arrival of further casualties [11,12,3]. In unconscious casualties with traumatic brain damage and no peripheral pulse, fluid resuscitation is recommended until the pulse of the radial artery becomes detectable [11,12,3,7]. It is also important to protect the casualty from heat loss by minimizing the time of exposure, drying the subject or changing the subject's clothes, placing the subject on an isolated surface and covering with a thermal blanket [11,12]. To prevent hypothermia, warmed fluids are used for fluid resuscitation [11,12]. In the case of eye injury, a quick field-of-view examination should be conducted and a protective bandage should be applied over the injured eye [11,12,4,7]. Pain management in

subjects with a retained ability to fight involves 15 mg Meloxicam administered orally once a day and 650 mg Paracetamol every 8 h. Casualties who are unable to fight receive 5 mg morphine intravenously or intramedullarily with the dose repeated every 10 minutes, if necessary. Constant observation of the subject for possible development of hypoventilation is necessary. If needed, naloxone should be administered.

Alternatively, 800 µg fentanyl may be used buccally. To prevent vomiting and enhance the action of analgesics, 25 mg promethazine may be administered I.V./I.O./I.M. every 6 h [11,13,3,7]. Use of antibiotics is indicated with all open wounds, including ocular wounds. In subjects who can swallow, 400 mg moxifloxacin is used orally once a day. Unconscious casualties receive I.V./I.M. 2 g cefotetan or I.V./I.M. 1 g ertapenem every 12 h [11,13,3,7]. At this stage, bone fractures are immobilized and the pulse of the injured limbs is controlled. Resuscitation of unconscious casualties with blunt or penetrating traumas, no pulse, not breathing or presenting any signs of life will not succeed and should not be undertaken in the field of battle [11,12,3,7]. However, in casualties with chest injuries or polytrauma who have no pulse or breath, bilateral chest puncture should be performed to exclude tension pneumothorax before abandoning resuscitation [12]. In the case of inhalational airway burns, surgical airway clearance is required [12]. Burns covering approx. 10% total body surface area (TBSA) are dressed with dry aseptic bandages. Burns covering >20% TBSA should be dressed with thermal blanket both to protect the wounds and to prevent heat loss [12]. What is more, in the case of such large burns it is indicated to perform fluid resuscitation based on the Rule of Ten established by the U.S. Army Institute of Surgical Research (USAISR). According to the rule, fluid volume to be infused to the casualty is calculate using the formula $\%TBSA \times 10 \text{ ml/h}$ in adults weighing 40–80 kg. Another 100 ml/h are added per each 10 kg weight exceeding 80 kg. Fluid resuscitation in burn treatment involves the use of lactated Ringer's solution, 0.9% NaCl or Hextend (up to 1000 ml) [12].

During tactical evacuation, the casualty is subjected to procedures indicated in earlier phases with an optional application of laryngeal mask, the Combitube airway and tracheal intubation.

If the chest puncture to relieve tension pneumothorax has been unsuccessful or a long transport time is expected, application of a chest drain should be considered. Using oxygen therapy is indicated in casualties with a low saturation level indicated by pulse oximeter or injuries involving poor ventilation, unconscious subjects or subjects with traumatic brain damage (maintain SpO₂ > 90 %)[11,12,3,7].

If signs of shock occur, apart from the actions taken during the previous stage, continuing fluid resuscitation using crystalloids or Hextend should be considered until a systolic pressure of 80–90 mmHg is obtained [6,11,12,3,7]. When shock is present, blood substitutes may be used, if available. Two plasma units and RBC concentrate may be administered at a ratio of 1:1. If those preparations are not available, full blood may be used [11,12]. In unconscious subjects with traumatic

brain damage and no peripheral pulse, fluid resuscitation is conducted until a systolic pressure of ≥90 mmHg is obtained [11,12,3,7]. Use of Pneumatic Antishock Garment (PASG) should be taken into consideration in casualties requiring stabilization of pelvic fractures and to control pelvic and abdominal haemorrhages. The method is contraindicated in subjects with craniocerebral or chest injuries [11,12,3,7]. At this stage, the subject's condition is monitored using pulse oximeter. Other vital signs are assessed as well. In casualties with no apparent lethal injuries, who experienced respiratory and cardiac arrest, cardiopulmonary resuscitation is acceptable at this stage, but only if the subject may soon reach a place where surgical intervention may be performed and mission objectives will not be compromised [12].

The range of competences of the personnel providing first aid to casualties is presented in Table 1.

Table 1: The range of competences under TCCC [3].

	Skills	Soldier	Combat Life Saver	Combat Medic
	Principles of tactical medicine	x	x	x
Dressing haemorrhages	Tourniquet	x	x	x
	Compression bandage	x	x	x
	HemCon® haemostatic bandage	x	x	x
	Military anti-shock trousers (MAST)			x
	Casualty transport techniques	x	x	x
Respiratory ways	Head-tilt/chin-lift manoeuvre	x	x	x
	Nasopharyngeal tube	x	x	x
	Tracheal puncture/tracheotomy			x
	Laryngeal mask			x
	Tracheal intubation			x
	Combitube airway			x
Ventilation	Relieving tension pneumothorax via needle chest puncture		x	x
	Securing open pneumothorax	x	x	x
	Chest drainage			x
	Oxygen supply			x
Intravenous line / therapy	Assessment of shock signs	x	x	x
	Intravenous line application		x	x
	Intramedullary line application			x
	I.V. Fluid resuscitation		x	x
	I.V. Analgesics administration			x
	I.V. Antibiotic therapy			x
	I.V. Blood and blood substitute administration			x
Intramuscular (I.M.) therapy	I.M. Morphine	x	x	x
	I.M. Antibiotic therapy			x
Oral (P.O.) medications	P.O. Analgesics	x	x	x
	P.O. Antibiotic therapy	x	x	x

	Skills	Soldier	Combat Life Saver	Combat Medic
Fractures	Immobilization using splint	x	x	x
	Immobilization using skeletal traction splint		x	x
Electronic monitoring				x

Conclusions

First aid in the field of battle is very limited due to high risk to the life saver's health and life. Involved actions are meant to prevent potentially reversible causes of cardiac arrest, such as hypovolaemia, hypoxia and tension pneumothorax by stopping haemorrhages using tourniquets or haemostatic bandages, chest puncture using needle, oxygen and fluid therapy. Providing Care Under Fire is limited to stopping life-threatening haemorrhages, while further relocations to safer places permit more methods of vital sign stabilization to be applied, including blood and blood

substitute transfusion during Tactical Evacuation. This paper refers to the standards set by TCCC and used mainly by the American and Canadian armed forces, however, the authors are aware that not all countries allow the use of the aforementioned methods by soldiers, combat life savers and combat medics under the pre-hospital care. Nonetheless, the effectiveness and safety of the procedures described in this paper has been widely studied and described in medical literature. Therefore the authors presumed that all recommendations were worth mentioning without their adaptation to the regulations of Polish Armed Forces.

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