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Assessment of the effectiveness of Tactical Combat Casualty Care training provided to non-medical military personnel in Türkiye

Procena efikasnosti obuke za Taktičko zbrinjavanje ranjenika u borbi za nemedicinsko vojno osoblje u Turskoj

Burcu Bayramoglu*, Betül Kaplan Zamanov†, Sinem Güzel Öztürk‡, Ismail Kaftancı*, Ismail Tayfur*

***University of Health Sciences, Sancaktepe Sehit Prof. Dr. Ilhan Varank Training and Research Hospital, Department of Emergency Medicine, Istanbul, Türkiye; †Department of Emergency Medicine, Göztepe Süleyman Yalçın City Hospital, Istanbul, Türkiye; ‡Yenişehir State Hospital, Department of Emergency Medicine, Bursa, Türkiye**

Abstract

Background/Aim. Tactical Combat Casualty Care (TCCC) protocols are trauma protocols used on the battlefield aimed at preventing death in the first hours of injury. In Türkiye, a regulation requires security and safety personnel to undergo TCCC training. This training is provided to non-medical military personnel (MPs) by specialized military and civilian healthcare professionals at various hospitals. The TCCC protocols include standardized interventions through protocols such as Massive hemorrhage, Airway, Respiration, Circulation, Hypothermia/Head injury (MARCH) protocol and Military Acute Concussion Evaluation (MACE) protocol to ensure consistency in trauma care. The aim of the study was to evaluate the effects of TCCC on MPs who received the training. **Methods.** The study included MPs who received TCCC training at Istanbul's Sancaktepe Hospital between March 7 and May 13, 2022, and between October 3 and December 2, 2022. Volunteers who consented to participate were asked survey questions to evaluate their knowledge before and after the training on various medical conditions to assess changes in knowledge and skills. Their opinions about the training were solicited both before and after the training. In addition to the survey questions, participants were asked to provide their views and suggestions about the training through open-ended questions. **Results.** The study included 49 volunteers aged between 23 and 35. There was a statistically significant increase in knowledge and skill levels regarding medical conditions before and after the training ($p < 0.001$). Participants concluded that the training was beneficial and that the knowledge and skills acquired could be applied in the field. **Conclusion.** Providing TCCC training will help MPs perform life-saving interventions under fire, thereby reducing fatalities and disabilities. Additionally, TCCC training will increase health literacy awareness among civilians, enabling trained personnel to not only save lives on the battlefield but also provide first aid in civilian emergencies.

Key words:
armed conflicts; emergency medicine; military personnel; models, theoretical; surveys and questionnaires.

Apstrakt

Uvod/Cilj. Protokoli Taktičkog zbrinjavanja ranjenika u borbi (*Tactical Combat Casualty Care* – TCCC) su protokoli za zbrinjavanje osoba sa povredama koji se koriste na bojnom polju sa ciljem sprečavanja smrti u prvim satima nakon povrede. U Turskoj, propis zahteva da pripadnici obezbeđenja i bezbednosnih snaga prođu obuku iz TCCC. Ovu obuku nemedicinskom vojnom osoblju (VO) pružaju specijalizovani vojni i civilni zdravstveni radnici u raznim bolnicama. Protokoli TCCC uključuju standardizovane intervencije kroz protokole kao što su protokol za kontrolu disanja, cirkulacije i prevenciju i zbrinjavanje masivnog krvarenje i povreda glave/hipotermiju (*Massive hemorrhage, Airway, Respiration, Circulation, Hypothermia/Head injury* – MARCH) i vojni protokol za akutnu procenu potresa mozga (*Military Acute Concussion Evaluation* – MACE) da bi se osigurala doslednost u zbrinjavanju trauma. Cilj rada bio je da se proceni efekat TCCC na VO koje je prošlo obuku. **Metode.** U studiju je bilo uključeno VO koje je prošlo TCCC obuku u bolnici *Sancaktepe* u Istanbulu u dva vremenska perioda, i to od 7. marta do 13. maja 2022. i od 3. oktobra do 2. decembra 2022. godine. Dobrovoljcima koji su pristali da učestvuju u istraživanju postavljena su pitanja iz upitnika, u vezi sa različitim medicinskim stanjima, u cilju procene promena u njihovom znanju i veštinama pre

Correspondence to: Burcu Bayramoglu, Department of Emergency Medicine, University of Health Sciences, Sancaktepe Sehit Prof. Dr. Ilhan Varank Training and Research Hospital, Emek, Namık Kemal Cd. No. 54, 34 785 Sancaktepe/İstanbul, Türkiye.
E–mail: drburcubayramoglu@gmail.com

i posle obuke. Mišljenje učesnika o obuci prikupljeno je i pre i posle završene obuke. Pored pitanja iz ankete, učesnici su zamoljeni da iznesu svoje stavove i sugestije o obuci putem pitanja otvorenog tipa. **Rezultati.** U studiju je bilo uključeno ukupno 49 dobrovoljaca životnog doba između 23 i 35 godina. Utvrđeno je statistički značajno povećanje nivoa znanja i veština nakon obuke u odnosu na stanje pre obuke ($p < 0,001$). Učesnici su zaključili da je obuka bila korisna i istakli da bi se stečena znanja i veštine mogli primeniti u realnim situacijama na terenu. **Zaključak.** Sprovođenje TCCC obuke pomoći će VO da efikasno primeni spasonosnu pomoć u borbenim uslovima čime će se smanjiti smrtnost i invaliditet među povređenima. Pored toga, TCCC obuka će povećati nivo zdravstvene pismenosti među civilima, omogućavajući obučenom VO ne samo da spasava živote na bojnom polju, već i da pruža prvu pomoć u civilnom okruženju u vanrednim situacijama.

Ključne reči:
sukob, oružani; medicina, urgentna; vojno osoblje; modeli, teorijski; ankete i upitnici.

Introduction

Tactical Combat Casualty Care (TCCC) encompasses trauma protocols utilized in combat scenarios, aiming to prevent fatalities within the crucial first hours following injury. These protocols commence with care under fire, proceed with casualty care on-site, and conclude with casualty evacuation [1]. Interventions that are particularly emphasized in the TCCC guidelines are tourniquet application (TA), control of external hemorrhage, administration of tranexamic acid, surgical airway management, needle decompression for tension pneumothorax, spinal protection in penetrating injuries, establishment of vascular access, fluid resuscitation in shock and hypotension, intraosseous vascular access, provision of analgesia, prevention of coagulopathy, administration of antibiotics, simulation-based scenario training, and the use of plasma in trauma resuscitation [2].

Regulations in Türkiye concerning the TCCC training of law enforcement and security personnel were published on March 22, 2016. In accordance with this regulation, military and civilian healthcare professionals specializing in emergency medicine (EM) provide TCCC training for military personnel (MP) who are non-medical professionals at various hospitals [3]. This training program includes theoretical and practical instruction, covering basic knowledge of human anatomy and physiology, physical examination, basic and advanced life support, airway management, vascular access techniques, trauma management, interventions for environmental emergencies, and actions to be taken when confronted with environmental emergencies. Through theoretical instruction and practical exercises, MPs are prepared to provide initial medical assistance in the absence of healthcare professionals. Following this training, MPs are expected to be able to perform life-saving interventions for injured personnel in field conditions or potential conflict zones until they reach medical facilities or until patients are transferred to healthcare personnel.

The aim of this study was to evaluate the opinions of personnel who underwent TCCC training provided by EM specialists, EM assistants, and auxiliary healthcare personnel serving in the EM clinic of our Hospital, as well as to assess the knowledge, skills, and behavioral changes resulting from the training.

Methods

Sample selection

The study included MPs who underwent TCCC training at our Hospital between March 7 and May 13, 2022, and also between October 3 and December 2, 2022, and agreed to participate. One MP who attended the training but declined to participate in the study was not included. The ethics approval for the study was obtained from the Ethics Committee of Sancaktepe Sehit Prof. Dr. Ilhan Varank Training and Research Hospital (No: E-46059653-050.99-215846834). The study was conducted in accordance with the Declaration of Helsinki.

Details of the training

The TCCC training provided at our Hospital consisted of both theoretical and practical sessions conducted over a period of eight weeks. EM specialists, EM assistants, emergency department nurses, and healthcare personnel from the national medical rescue team delivered this training. The theoretical component of the training, the first stage, involved presentations using Microsoft PowerPoint software by EM specialists. Models were used as needed during these presentations. Necessary medical devices and equipment were introduced, and their principles of use were explained. The second stage of the training involved practical exercises and drills based on scenarios.

Research design

Volunteers who consented to participate in the study were evaluated both before and after training to assess changes in their knowledge and skills using a five-point Likert scale (1 – no knowledge; 2 – limited knowledge; 3 – moderate knowledge; 4 – good knowledge; 5 – excellent knowledge). Survey questions were directed to measure the level of knowledge regarding fundamental concepts and definitions, respiratory physiology, respiratory system physical examination, vertebral examination, pulse examination, cardiopulmonary resuscitation and its quality, hemorrhage, bleeding control, shock, TA, Massive hemorrhage, Airway, respiration, Circulation, Hypothermia/Head injury (MARCH) protocol, on-site patient assessment, intervention

for thoracic injuries on-site, medical care under fire, explosion and gunshot injuries, intervention for patients in a hot environment, limb amputations, intervention for limb amputations, Military Acute Concussion Evaluation (MACE) protocol, assessment of consciousness status, signs of respiratory distress, airway management, airway opening maneuvers, anaphylaxis, high-altitude illnesses, epistaxis, hypothermia/frostbite, eye irrigation, wound care, and application of dressings (Table 1).

Prior to training, participants' opinions regarding the potential benefits of the training were assessed using a three-point Likert scale (1 – no opinion; 2 – undecided; 3 – believed training would be beneficial). In the survey conducted after training, the participants' opinions concerning the effectiveness of the training and the applicability of the acquired knowledge in the field were evaluated using a three-point Likert scale (for the usefulness of training: 1 – I do not think it was beneficial, 2 – I am undecided, and 3 – I think it was beneficial; for the applicability of the acquired knowledge in the field: 1 – I cannot apply it, 2 – I am undecided, and 3 – I can apply it). In addition to the survey questions, the participants were asked to express their views and suggestions regarding the training through open-ended questions.

The volunteers were asked survey questions in their native language. Care was taken to ensure that the questions were clear, understandable, free of medical terminology, and as close to daily language as possible. After analyzing the responses to the survey questions using statistical methods, the questions were subsequently translated into English.

Data collection tool

A survey consisting of questions prepared through Google Forms was administered to the MPs participating in the two training groups, comprising a total of 63 individuals, *via* the WhatsApp application. Prior to accessing the survey questions, the participants were required to read the informed consent form and confirm if they were willing to participate. The completion of the informed consent form was mandatory for accessing the survey questions.

Statistical analysis

The mean age of the volunteers and the percentages of responses to the survey questions were recorded. Mean values and standard deviations of scores obtained from the Likert scales were calculated, and statistical analysis was performed using the Wilcoxon signed-rank test. Significance

Table 1

Main topics and subheadings covered in the tactical combat casualty care training

Main topics	Subheadings
Basic definitions/anatomy and physiology	stress definition
	functions of the skin
	respiratory rate of a normal adult
Physical examination	thoracic examination
	vertebral examination
	pulse check
Cardiopulmonary resuscitation	high-quality chest compressions
	cardiopulmonary resuscitation
	components of basic life support
Shock and bleeding control	hemorrhage
	tourniquet application
	bleeding control
	shock
MARCH protocol	MARCH protocol and its components
Patient intervention and care under fire and in the field	on-site patient assessment
	intervention for thoracic injuries on-site
	medical care under fire
	explosion and gunshot injuries
	medical care for patients in the hot zone
	intervention for head trauma in the hot zone
Limb amputations	limb amputations
	intervention for limb amputations
Altered consciousness	MACE protocol
	assessment of consciousness status
Airway assessment and management	signs of respiratory distress
	airway management
	airway opening maneuvers
Various clinical situations	anaphylaxis
	high-altitude illnesses
	epistaxis
	hypothermia/frostbite
Wound care and interventional procedures	eye irrigation
	wound care/dressing applications

MARCH – Massive hemorrhage, Airway, Respiration, Circulation, Hypothermia/Head injury; MACE – Military Acute Concussion Evaluation.

was set at $p < 0.001$. The Statistical Package for the Social Sciences (SPSS) for Windows v. 26 (IBM Corporation, Chicago, Illinois) was utilized for statistical analysis.

Results

Forty-nine volunteers consented to participate in the study and answered the survey questions. The mean age of the volunteers was 29.47 (min 23, max 35) years.

Table 2 shows the percentages of the participants' response scores on the Likert scale before and after training.

The statistical comparison of the score averages of the questions and sections before and after training revealed a statistically significant difference ($p < 0.001$). However, there was no statistically significant difference between the pre- and post-training scores concerning the perceived usefulness of the training. The participants expressed their belief in the training's potential benefits before training and confirmed its effectiveness after training ($p = 0.189$) (Table 3). Through open-ended questions, the participants were asked about the skills acquired after training and the perceived benefits of the training. The acquired skills emphasized post-training included triage, providing initial care under fire, medication use, TA, and basic and advanced life support. Regarding the perceived benefits of the training, the participants highlighted the importance of gaining the ability to intervene and provide care under fire.

Table 2

Responses to the Likert scale questions directed to the participants before and after training

Training topic	Before training					After training				
	1	2	3	4	5	1	2	3	4	5
Basic definitions/anatomy and physiology	22.40	38.90	25.20	12.2	1.30	1.30	2.80	4.10	57.00	34.80
Physical examination	38.10	41.30	15.30	3.70	1.60	1.33	2.00	6.13	43.56	46.98
Cardiopulmonary resuscitation	44.96	32.27	17.47	5.30	0	1.33	2.73	5.46	44.22	46.26
Shock and bleeding control	26.60	43.00	11.50	17.00	1.90	0	2.52	2.06	39.30	56.12
MARCH protocol	70.60	19.85	4.75	3.20	1.60	1.00	3.05	3.05	51.00	41.90
Patient intervention and care under fire and in the field	32.42	38.80	20.40	7.70	0.68	0.85	1.80	2.90	45.47	48.98
Altered consciousness	56.35	29.35	6.35	7.95	0	2.00	1.00	6.10	50.00	40.90
Airway assessment and management	37.56	35.43	15.38	10.03	1.60	0.70	2.70	1.37	44.23	51.00
Various clinical situations	45.65	33.75	13.50	6.70	0.40	2.00	2.58	6.12	38.80	50.50
Wound care and interventional procedures	30.67	31.73	27.00	9.53	1.07	0.70	2.00	4.76	37.42	55.12
Opinions about training										
usefulness of training	11.10	9.50	79.40	-	-	4.10	0	95.90	-	-
applicability of acquired knowledge in the field	-	-	-	-	-	0	4.1	95.90	-	-

Values are given as percentages.

***Note*: for "Opinions about training", participants' opinions were assessed using the first three points of the Likert scale; for the applicability of acquired knowledge, it was impossible to give answers before the training was conducted.**

For the 5-point Likert scale response options, see the Methods section.

Table 3

Statistical analysis of responses before and after training

Training topic	Before training	After training	*p-values
Basic definitions/anatomy and physiology	2.31 ± 0.92	4.21 ± 0.73	< 0.001
Physical examination	1.75 ± 0.64	4.42 ± 0.64	< 0.001
Cardiopulmonary resuscitation	2.08 ± 0.74	4.31 ± 0.71	< 0.001
Shock and bleeding control	1.95 ± 0.72	4.43 ± 0.59	< 0.001
MARCH protocol	1.39 ± 0.73	4.53 ± 0.54	< 0.001
Patient intervention and care under fire and in the field	1.93 ± 0.70	4.35 ± 0.65	< 0.001
Altered consciousness	1.58 ± 0.42	4.32 ± 0.73	< 0.001
Airway assessment and management	2.09 ± 0.81	4.40 ± 0.64	< 0.001
Various clinical situations	2.04 ± 0.75	4.33 ± 0.79	< 0.001
Wound care and interventional procedures	2.10 ± 0.73	4.44 ± 0.70	< 0.001
Usefulness of training	2.68 ± 0.67	2.92 ± 0.40	0.189

MARCH – Massive hemorrhage, Airway, Respiration, Circulation, Hypothermia/Head injury.

Values are given as mean values ± standard deviation. *Wilcoxon signed-ranks test; significance: $p < 0.001$.

Discussion

In our study, when assessing the knowledge of MPs who received tactical field training, it was observed that there was a significant increase in their level of knowledge after training compared to before training. The participants believed the training would be beneficial before training, and kept the opinion that it was indeed beneficial after training.

Wars result in both material and moral losses for all parties involved. Deaths or injuries sustained by soldiers during wars lead to a loss of strength on the battlefield. Therefore, providing life-saving interventions to wounded soldiers on the battlefield and preventing possible disabilities are crucial. Rapid and accurate administration of such interventions on the battlefield ensures that injured soldiers not only survive and continue fighting but can also return to civilian life without significant disabilities after the war. Furthermore, receiving TCCC training will enable soldiers to intervene in medical emergencies they may encounter after returning to civilian life.

The first hour following trauma and the interventions that can be performed during this time are crucial determinants of survival and are often referred to as the "golden hour" [4]. In war, many deaths occur before reaching centers where professional medical care can be provided. In a study investigating deaths on the battlefield in the USA from 2001 to 2011, it was found that 87.3% of deaths occurred before reaching any medical facility. Furthermore, 90.9% of mortality was attributed to hemorrhage, with 33.7% of hemorrhages originating from extremities [5]. Extremity hemorrhage has been identified as the most common cause of preventable deaths during the Vietnam War [6]. Hence, TA emerges as a key aspect of battlefield care. While tourniquet use, a primary component of TCCC training, can be life-saving in hemorrhage-related deaths on the battlefield, incorrect or delayed application may lead to various neurovascular deficits and limb losses. In a study examining 69 injured individuals who underwent TA in a hospital treating Ukrainian military personnel, the accuracy rate of applied tourniquets was found to be 24.6%. It was observed that tourniquets were applied late in 8 cases with over 1 L of blood loss and were incorrectly applied in 12 cases [7]. In a study conducted by Schreckengaust et al. [8], volunteers who received training on TA as part of TCCC training and who were subsequently requested to apply tourniquets in a battlefield simulation demonstrated a correct application rate of 87% on the first day, which increased to 94% on the fourth day, with TA times reduced from 43 s to 38 s. It was found that the training provided shortened the time for TA and effectively stopped arterial flow [8]. In our study, we found a statistically significant increase in the participants' level of knowledge regarding TA after training. Additionally, 95.9% of participating MPs indicated that they could apply the knowledge and skills acquired during training on the battlefield. Correct application of tourniquets is crucial in the care of injured individuals under fire and in hot zones. TCCC training emphasizes the importance of tourniquet use. Efforts should be made to improve the accuracy of the TA through training and repeated training sessions.

In a study conducted with the Chinese army, participants were divided into three groups: reserve officers who had received military training (MT) but not medical education; those who had received medical education in addition to MT and had undergone 40 hrs of first aid training *per* year; fresh officers who had undergone 10 hrs of first aid training *per* year. A new curriculum was developed for officers who had received MT but not medical education, and the performance of these three groups on the battlefield was evaluated from a medical perspective. It was observed that the officers who had received training under the new curriculum achieved similar scores to those who had received medical education in addition to MT and had undergone 40 hrs of first aid training *per* year. In addition, both of these groups outperformed the fresh officers who had undergone 10 hrs of first aid training *per* year [9]. This study demonstrates that personnel without medical education can attain the necessary skills to perform interventions on the battlefield through TCCC training. Similarly, our study revealed an increase in the knowledge levels of MPs regarding the topics covered in the training. Furthermore, it was observed that the participants acquired the ability to perform interventional procedures through practical exercises.

TCCC training should be repeated at regular intervals for personnel who have received it. During the recertification of nine US National Guard soldiers who had previously undergone TCCC training, six questions related to TCCC guidelines were posed, and their performance in applying tourniquets and stopping bleeding was evaluated. On average, 2.2 of the questions were answered correctly, with a success rate of 44% for TA and 22.2% for bleeding control. The authors emphasized the necessity of providing TCCC training at regular intervals and conducting recertification [10]. Another study undertaken by Oury et al. [1] examined the effect of trauma center-based education on procedural skills, medical knowledge, and confidence in application among special operations medical personnel. The study included a total of 108 students from 18 courses conducted over a period of two years. The results showed a 2% increase between the pre- and post-test scores; this increase was not statistically significant. Nevertheless, there was a significant increase in the participants' confidence levels in the application of procedural skills, such as cricothyrotomy, chest tube insertion, TA, FAST examination, needle thoracostomy, and airway management, as well as general patient care skills. Similarly, in our study, it was observed that 95.9% of the MPs who participated in the TCCC training developed confidence in their ability to apply the knowledge and skills they acquired in the field.

Suresh et al. [11] evaluated the pre-deployment training, confidence, and preparedness feelings of military health personnel deployed to war zones through an online survey. According to the participants, the most important skills were related to controlling bleeding, administering

treatment/medication, providing care during combat, and managing burns. Of the 254 participants, 74.8% expressed confidence in their combat casualty care skills. The study found that confidence increased with the number of deployments and the duration of pre-deployment training. Similarly, in our study, the participants highlighted the importance of skills acquired in triage, providing initial care under fire, medication administration, TA, and basic and advanced life support after training.

TCCC training primarily aims to enable MPs to perform life-saving interventions on the battlefield. Furthermore, a study that provided law enforcement personnel with training based on TCCC guidelines and examined cases where they intervened from a medical perspective found that those who received the training were able to perform life-saving interventions. Notably, successful results were achieved in bleeding control [12]. The study demonstrated that the training provided could be utilized not only on the battlefield but also in civilian life.

Conclusion

Providing TCCC training to military personnel and repeating it regularly will enable them to perform life-saving interventions under fire, resulting in reduced fatalities and disabilities. Periodic repetition of training will facilitate the refreshing of knowledge, the learning of new intervention techniques, if applicable, the transfer of experience in military medicine, and the acquisition of different perspectives. Therefore, enhancing and sustaining TCCC training *via* new methods and viewpoints is essential. In addition, TCCC training will foster health literacy among civilians, equipping trained individuals to not only save lives on the battlefield but also provide immediate emergency assistance in civilian life. This further underscores the growing importance of TCCC training with each passing day.

Conflict of interest

The authors declare no conflict of interest.

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