The Effectiveness of Basic Resuscitation Activities Carried out by Combat Paramedics of the Police, as Exemplified by Polish Counterterrorist Units

Waldemar Zubrzycki
ORCID: 0000-0002-2790-4005
Police Academy in Szczytno, Poland

Jarosław Przyjemczak
ORCID: 0000-0003-3923-8078
Independent Counterterrorism Subunit of the Police in Gdańsk, Poland

Beata Świeczko-Żurek
ORCID: 0000-0001-7742-0052
Gdańsk University of Technology, Poland

Abstract. *The tasks carried out by Police officers are often accompanied by dangerous situations that threaten the life and health of the people involved, the police themselves, and bystanders. It concerns especially counter-terrorism police units whose activities are aimed at terrorists and particularly dangerous criminals, and their course is violent and aggressive. In conjunction with the inability to bring civilian rescue services into the action zone, this results in the need to expand the assault team by including one more specialisation — combat paramedic, having the appropriate knowledge, skills and qualifications, as well as equipment that allows for independent first aid while the operations are underway. A paramedic's preparation must be versatile, but the key to effective action is the ability to perform basic activities, including cardiopulmonary resuscitation, after the diagnosis of sudden cardiac arrest. The study aims to present the results of research conducted on a fairly unique research sample regarding the effectiveness of indirect heart massage by combat paramedics of police special units and conclusions resulting from empirical research and their comparison with the results of similar studies, in relation to other professional groups. The knowledge and skills acquired during the training quickly become obsolete, requiring systematic consolidation and improvement. Therefore, cyclical repetition of exercises in the area of rescue activities plays a key role in maintaining the required quality of life support. The collected material may be a premise for further research, indicating their potential directions.*

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Introduction

In the course of daily police tasks, dangerous situations that threaten life or health are common. The need for police officers to provide first aid results not only from their personal values and norms of social coexistence but also from normative acts, in light of which they are obliged to provide it to every single person injured as a result of police activities.

Sometimes the use of force is required to enforce obedience of the law, which especially applies to activities in which counterterrorism police units are used. The

tasks realised by them are targeted at terrorists and especially dangerous criminals, which is why these actions usually have a sudden and aggressive course, during which all available levels of force continuum, including firearms, are used. This increases the probability of every participant in the action being hurt, including threat to the health or even lives of those towards whom the actions are directed, police officers and also bystanders. In these circumstances, life-saving activities become a necessity, often before completing the tasks that are realised at the same moment. This in turn means the inability of receiving support from civilian rescue services, which necessitates the acquisition of knowledge, skills and qualifications, as well as of equipment that enables independent provision of first aid, while continuing the action. That kind of need was at the root of the expansion of the counterterrorist combat squad with another specialisation — paramedic, which requires special training. A combat paramedic is a police officer who is a part of an assault group, executing combat tasks, with specialist knowledge, skills and equipment to perform activities related to first aid where the action takes place, according to authorisations held. This is someone able to provide first aid to a person injured during the action performed, in order to stabilise a victim's health situation, evacuate them from the danger zone or transport them to hospital. A paramedic is responsible for providing first aid and looking after the person who was injured in the tactical environment. That means not only the necessity to provide first aid in non-hospital conditions with limited resources but also in the conditions of hostile influence of the enemy, under the pressure of time and of the situation, when one's own life and health are in danger[1].

The second element of the 'chain of survival', after recognising Sudden Cardiac Arrest (SCA), is the cardiopulmonary resuscitation (CPR), which is meant to deliver oxygen to tissues, especially those most sensitive to its lack — neurons of the central nervous system and cardiomyocytes. CPR has to be carried out in the first few minutes after the SCA occurs before the ischaemic changes become irreversible[2]. In the last several decades we can observe a shift of major importance from oxygen supply to blood supply. The research shows that even during a cardiac arrest, blood oxygen saturation is sufficient to keep the victim alive for a longer time than previously thought, provided that its flow is maintained[3].

Survival after cardiac arrest in non-hospital conditions is strictly related to the skills of the witnesses of an accident during which the SCA occurred. Regardless of where the accident took place, immediate initiation of BLS procedures, appropriate depth of compression of the chest and correct respiratory volume delivered to the lungs increases the probability of survival[4]. In the above scope, current recommendations also draw attention to the proper frequency of compressions and relaxations of the chest. Moreover, cyclical changes of resuscitators — every

[1] Zubrzycki W, Przyjemczak J, Paramedyk. Gdańsk, 2018, pp. 37–38.

[2] Kmiotczyk W, Resustytacja według wytycznych PRC/ERC. *Acta Bio-Optica et Informatica Medica*, 2010, Vol. 16, No. 1, p. 78.

[3] *Ibid.*

[4] *Cf.*: Kardong-Edgren S.E, Oermann M.H, Odom-Maryon T, Ha Y, Comparison of two instructional modalities for nursing student CPR skill acquisition. *Resuscitation*, 2010, Vol. 81, No. 8, pp. 1019–1024; Wik L, Myklebust H, Auestad B.H, Steen P.A, Twelve-month retention of CPR skills with automatic correcting verbal feedback. *Resuscitation*, 2005, Vol. 66, No. 1, pp. 27–30.

2 minutes are recommended[5]. In practice, it happens that CPR — even when performed by qualified medical staff — might be insufficient or ineffective. Previous studies indicate the inadequate quality of the obtained resuscitation parameters, performed even by doctors or nurses with appropriate training[6].

Many authors underline that the quality and frequency of chest compressions are an indispensable condition of CPR effectiveness[7]. The proper method of administering compressions is strictly defined in the guidelines of the American Heart Association and the European Resuscitation Council. Regardless of the patient and circumstances, the chest should be compressed to a depth of 5–6 cm with its full relaxation and the frequency of compressions from 100 to 120 per minute[8]. To avoid premature fatigue of the paramedic performing the CPR, it is recommended — only if possible — to change the resuscitator every 2 minutes[9]. This condition cannot be always fulfilled, especially in dynamic police actions, during which the priority is the implementation of the task assigned. Therefore, the effectiveness of performing CPR in the course of action might be disturbed by the impossibility to engage another person in its performance, and chaos that may occur at the scene[10], combined with the well-founded fear for one's own health, or even life.

Cardiopulmonary resuscitation was one of the issues raised during a staff training course addressed to paramedics of special police units. During the course, an examination of the quality of CPR delivery, taking into account the criteria described, was carried out.

Objective

The purpose of this study is to present the result of the examinations, considering the effectiveness of indirect heart massage performed by Paramedics from Special Police Units during a staff training course in cardiopulmonary resuscitation. Moreover, conclusions were stated in it, considering proper preparation to performing that type of activities. These conclusions are derived from the obtained

[5] Więch P, Muster M, Bazaliński D, Kucaba G, Sałacińska I, Binkowska-Bury M, Wybrane parametry jakości ucisku i relaksacji klatki piersiowej wykonywanej przez personel pielęgniarski w ramach pozaszpitalnego nagłego zatrzymania krążenia — badanie pilotażowe. *Medycyna Rodzinna*, 2018, Vol. 21, No. 4, p. 329.

[6] *See:* Abella B.S, Alvarado J.P, Myklebust H, Edelson D.P, Barry A, O'Hearn N, Vanden T.L, Beckr L.B, Quality of cardiopulmonary resuscitation during in-hospital cardiac arrest. *Jama*, 2005, January 19, Vol. 293, No. 3, pp. 305–310; Dine C.J, Gersh R.E, Eary M, Riegel B.J, Bellini L.M, Abella B.S, Improving cardiopulmonary resuscitation quality and resuscitation training by combining audiovisual feedback and debriefing. *Crit Care Med*, 2008, Vol. 36, No. 10, pp. 2817–2822; Smith K.K, Gilcreast D, Pierce K, Evaluation of staff's retention of ACLS and BLS skills. *Resuscitation*, 2008, Vol. 78, No. 1, pp. 59–65.

[7] Więch P, *et al.*, p. 333.

[8] Krawczyk K, Czy dobrze uciskamy klatkę piersiową? *Electronic source:* https://www.mp.pl/ratownictwo/na-dyzurze/193294,czy-dobrze-uciskamy-klatke-piersiowa, *accessed:* 2.07.2020.

[9] *Ibid.*

[10] *Cf.*: Więch P, *et al.*, p. 329.

results of empirical research and their comparison with results of similar research in relation to other professional groups.

Methodology

During the practical courses, research was carried out. It consisted in registering the correctness of the activities performed under the influence of stress factors. The research took place on 25th September 2018 and involved 112 people with great differences between their rescue skills. The measurement was carried out using the TrueCPR device with v1.04.SVN.000.2052 software, which was connected with a set of sensors placed on Laerdal Little Ann QCPR mannequins. The obtained data included information on the way and quality of compressions performed on the mannequin's chest. The level of stress in the organisers' assumptions was meant to be raised by the following factors:

- pressure resulting from the presence of many people at the place of the life-saving drills, including a group of other trainees, observers and members of the assessment team;
- registration of the quality of the actions performed;
- the element of evaluation and competition
- random selection of mannequins that are the subject of quality registration.

A single attempt consisted of a 2-minute CPR exercise cycle on four mannequins at once. One mannequin was used by 2 rescuers. The change of the person performing chest compressions occurred after 1 minute. The programme took measurements from random mannequins so that participants did not know which mannequin is being monitored for the quality of CPR. A group of eight paramedics started the exercise on the 'Start' command and performed indirect heart massage individually for the next two minutes until the command 'Stop' was issued. The computer connected with the sensors on the mannequin, collected data on the course of exercise, generating a total of 28 reports on indirect heart massage performed by the participants. The measured elements included:

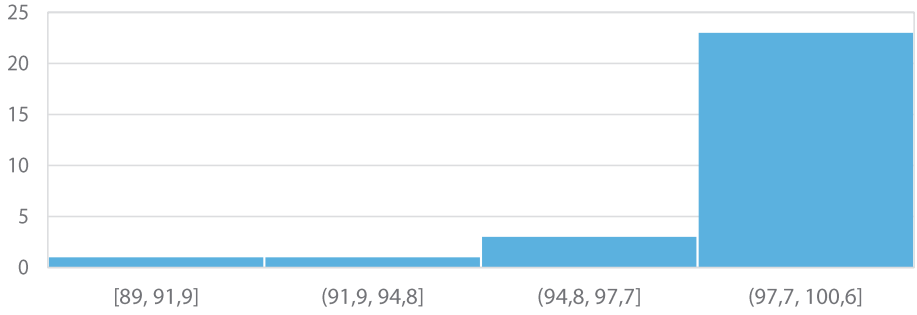
- measurement time utilisation index (percentage of the time used by the paramedic to provide compressions in relation to the duration of the measurement),
- number of compressions performed correctly in relation to all compressions,
- the depth of compression performed by the practitioner and the percentage of compressions performed correctly to the total number of chest compressions,
- level of relaxation (return of the chest to its natural position) expressed as a percentage of the number of times when the chest returned to its natural position correctly and incorrectly,
- frequency of compressions administered within one minute and the percentage of correct compressions to all compressions, as well as compressions administered 'too fast' and 'too slow'.

The analysis of the relevant literature has also been performed, while general research methods were used to process the results, including analysis, synthesis, comparison, generalisation and summarising.

Results

Percentage indicator of the time utilised by the paramedic for administering compressions in relation to the length of measurements in the majority of examined cases (23 reports) was shaped on the level of effective use of the time assumed for resuscitation activities (figure 1). According to measurements taken, in three cases practitioners performed these activities in the range of 94–97% of the allotted time and in 2 cases they were acting effectively in less than 95%.

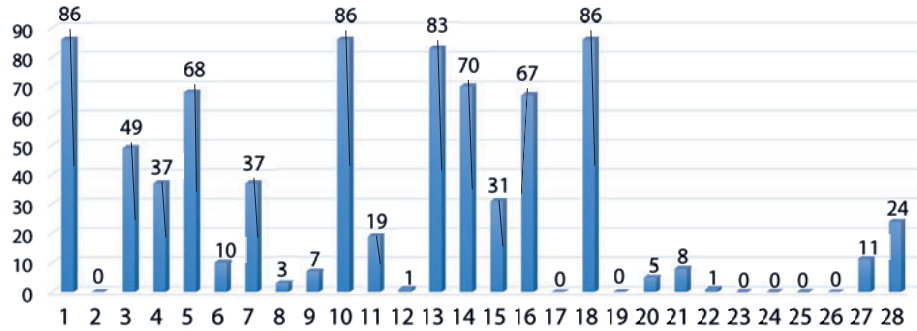
Figure 1. The percentage value of utilisation of the entire measurement time for performing indirect heart massage



Source: Authors' own study.

The results of measuring the number of correctly administered chest compressions, in the context of all compressions performed, are graphically illustrated in Figure 2. It should be noted that only in four of the 28 exercises tested, practitioners obtained the result of over 80% correctly administered compressions. There were three pairs of exercisers in the 50–70% range, four obtained the result of 30–49%, and another four — 10–29%. Six pairs obtained the result in the 1–9% range, while the largest number of participant, as many as 7 pairs, administered all the compressions incorrectly.

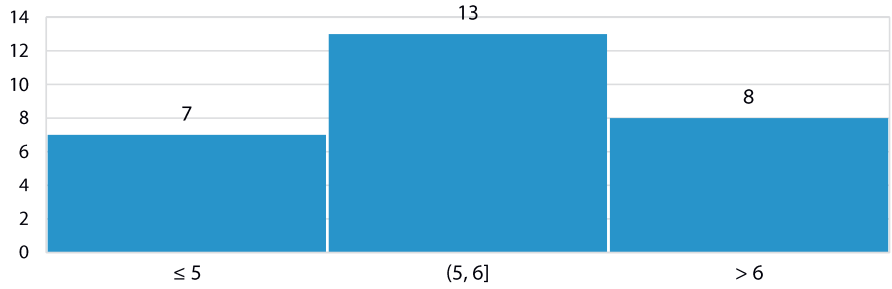
Figure 2. The percentage of correctly administered cardiac compressions during a two-minute cycle



Source: Authors' own study.

Another parameter measured during the performance of CPR activities by practitioners concerned the depth of the administered chest compressions. On 28 reports, 13 participants administered heart compressions in the normal range of 5–6 cm, another 8 performed compressions deeper than the accepted standard and in the remaining 7 cases — the compression depth was more shallow than the accepted standard (Figure 3).

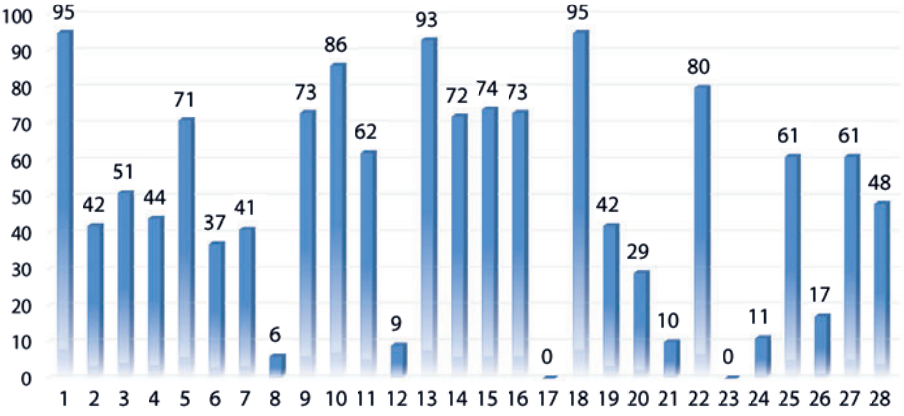
Figure 3. The range of mean depth values obtained while exercising heart compressions



Source: Authors' own study.

Values of compressions administered by individual subjects, which were within the normal range of 5–6 cm are shown in Figure 4. As can be seen, none of the pairs taking part in the exercises obtained 100% effectiveness and too deep or too shallow compressions could be seen in every analysed cycle. Three pairs obtained the result of more than 93% of compressions, two pairs performed this activity at the level of 80–86%, five of them did the task in the range of 70–79%, four in the range of 50–61%, another five obtained results in the range of 40–49%. A result below 37% was obtained by as many as 7 pairs, while two did not perform any compression in the required depth range (Figure 4).

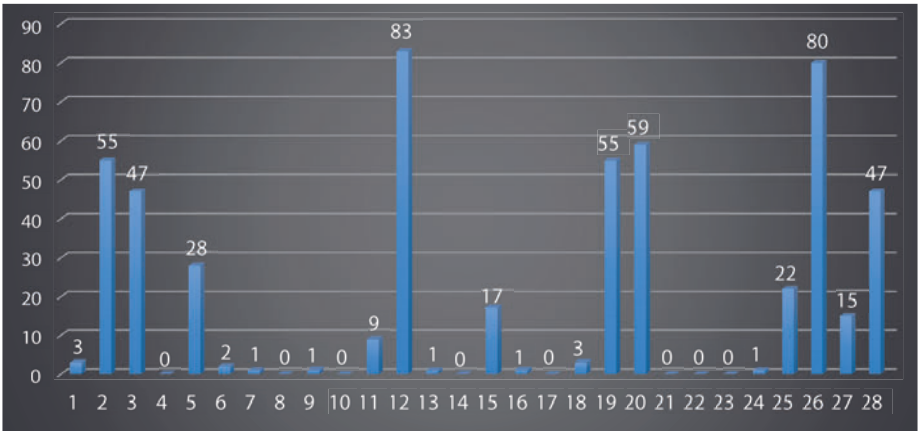
Figure 4. The percentage of correct depth of compressions administered by individual subjects



Source: Authors' own study.

The number of too shallow compressions administered by participants, *i.e.* those to a depth of less than 5 cm. Among all participants, two pairs performed such compressions in more than 80% cases, in the case of three pairs that parameter resulted in the range of 55–59%, two pairs obtained a result of 47%, four pairs performed this task with an error rate of 15–28%, seventeen pairs of participants administered less than 9% of too shallow compressions (Figure 5).

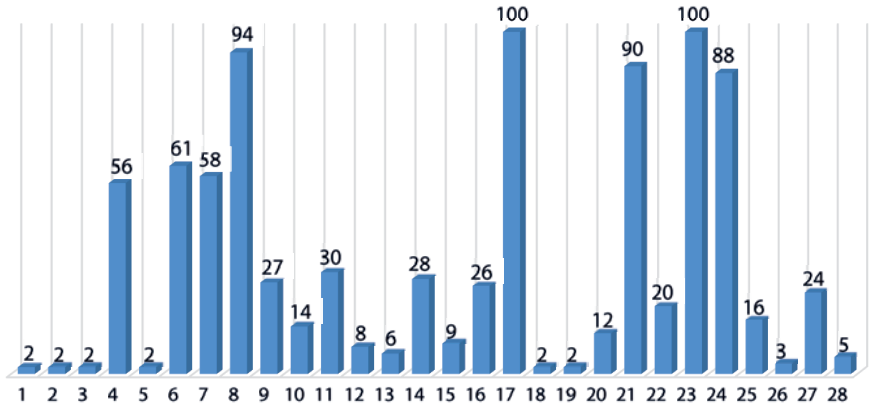
Figure 5. The number of compressions below the required depth



Source: Authors' own study.

Another parameter measured was too deep compressions. In the case of two pairs of participants, all the administered compressions were too deep, for three pairs 88–94% of compressions were too deep, for three pairs this parameter was in the range of 56–61% and for nine pairs — between 12 and 27%. A result below 10% of too deep compressions was obtained by 11 pairs (Figure 6).

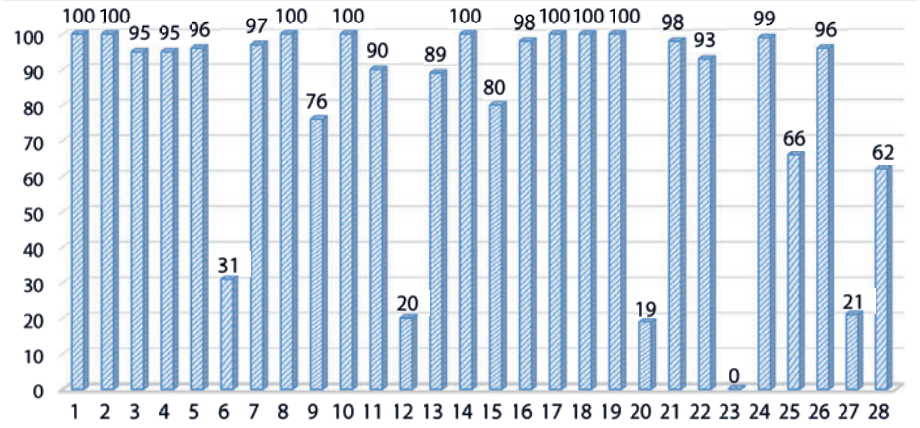
Figure 6. The percentage value of compressions deeper than required



Source: Authors' own study.

The relaxation of the chest is its returning to its natural position between compressions. The majority of the participants, 17 pairs, performed this activity in the range of 90–100% correctness. Three pairs obtained results between 76 and 89%, another two at the level of 62–66%, four pairs obtained the full relaxation of the chest in the range of 19–31% and only one pair performed no compressions that would be followed by full chest relaxation (Figure 7).

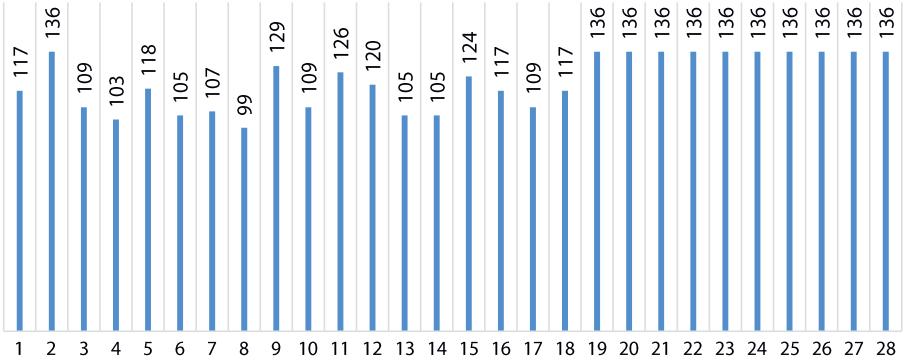
Figure 7. Correctness of chest relaxation after compression expressed as a percentage value



Source: Authors' own study.

As per the current standard, the rate of chest compressions during CPR should be 100–120 compressions per minute. An analysis of the frequency with which the paramedics compressed the chest showed that 11 pairs performed these compressions too fast (136/min), while 17 pairs maintained the correct frequency, which only in few cases was slightly different from the norm (Figure 8).

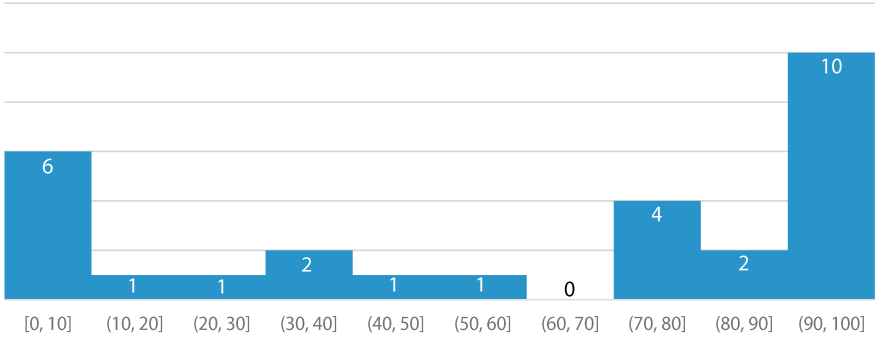
Figure 8. The average rate of cardiac compressions per minute



Source: Authors' own study.

Figure 9 presents the percentage value of compressions performed by participants with the correct frequency. Ten pairs performed the exercise maintaining the expected pace of work at 90–100%, two were in the range of 80–90%, four obtained the result of 70–80%, one was in the range of 50–60%, while 11 pairs obtained results below 50% of correct rate of performed compressions.

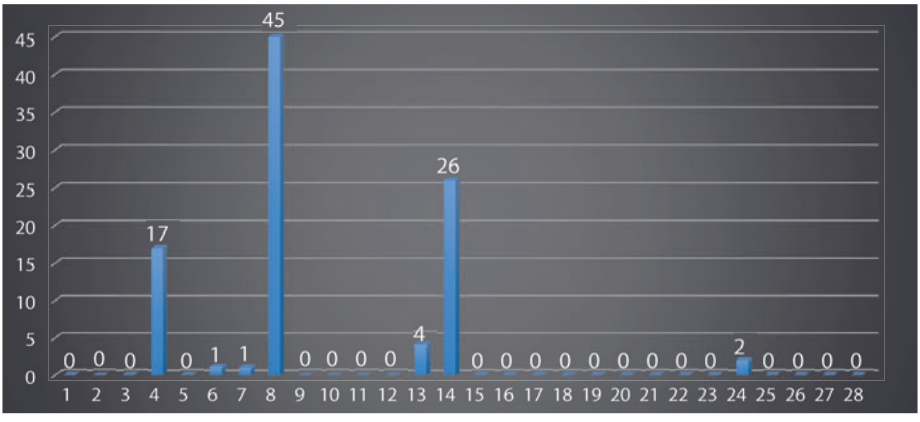
Figure 9. The percentage value of compressions performed at the correct pace



Source: Authors' own study.

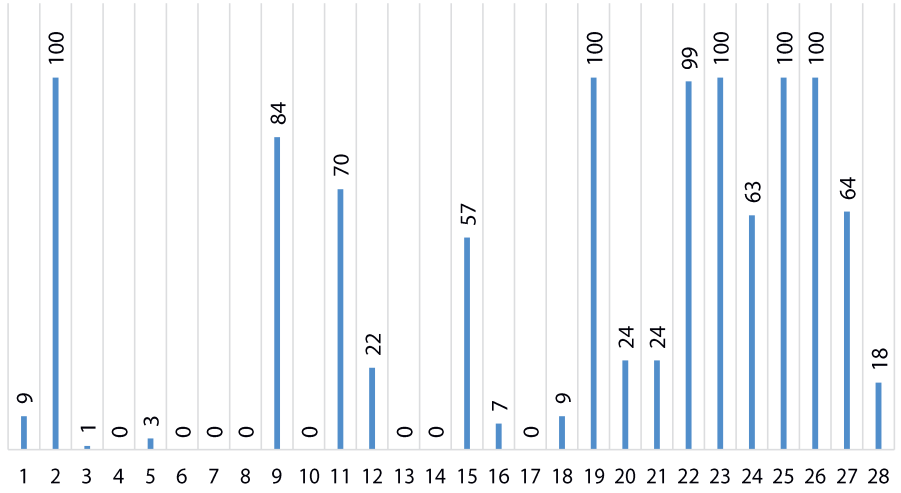
The conducted measurements provided knowledge about compressions administered by the exercisers at too slow and too fast a pace. Regarding too slow compressions, one pair obtained a result of 45 such compressions, two administered 17–26 too slow or too fast compressions, and 25 performed the test correctly, possibly too slowly, only in individual cases (Figure 10). Significantly more compressions were administered at a too fast pace. Six pairs administered nearly 100 too fast compressions, four pairs performed 57–84 such compressions, another four were in the range of 18–24, while 13 performed compressions at the right pace or their number of too fast compressions was below 10 (figure 11).

Figure 10. The number of compressions performed too slowly



Source: Authors' own study.

Figure 11. The number of compressions performed too fast



Source: Authors' own study.

The study was aimed at determining the correctness of performing the activities of indirect heart massage, carried out by participants of medical and tactical staff training dedicated to combat paramedics from Police Special Units. The analysed group was characterised by a diversified level of medical skills and knowledge, at the same time, individual participants declared systematic improvement of their competences in the field of first aid. The subject of the research concerned the basic medical skills which every single paramedic should have, in theory the assigned task should therefore cause no major problems in terms of their correct application. Based on obtained results it can be stated that increasing stress level resulted in all exercisers carrying out indirect heart massage in a way — in many cases significantly — deviating from the ideal. Many of them made mistakes that are common for beginners in the first stages of learning how to provide CPR, such as: inadequate pace, inadequate depth of cardiac massage, or incomplete chest relaxation. In general, a significant number of incorrectly performed compressions was found, in relation to the correct ones, which may indicate the neglect by the participants of systematic exercises in the scope of basic cardiac resuscitation. If the reasons for such a state of affairs are to be attributed to the increased level of stress, it should be noted that the research covered individuals who belonged to units that carried out special tasks, with a mental resistance higher than average. There is also no doubt that the level of stress that accompanies saving lives in reality, *i.e.* in direct contact with the victim, would be higher than in any simulated conditions.

The obtained results may be rather surprising, especially from the perspective of the patient, who has the right to expect thoroughly professional actions from properly trained personnel, especially at such a basic level. However, research has shown that this is not the question of the professional group represented in it, namely of paramedics of special units.

A similar assessment of the effectiveness of the second link of the so-called 'chain of survival' in terms of quality of the parameters of compressions and relaxations of the chest, was performed for nurses in simulated pre-hospital conditions. In a four-stage study, carried out by J. Mokhtari Nori on a group of 112 individuals, researchers assessed the level of knowledge and psychomotor skills of the respondents, showing that their level of knowledge and skills related to CPR was unsatisfactory[11]. Other authors also obtained similar results. In confrontation with the presented research results, it is also worth mentioning the results obtained by Sebastian Russo and his co-workers, as they clearly indicate the direction in which rescuers should follow. They relate to CPR training in a group of nurses, where — following a four-hour training program — a significant improvement in knowledge and psychomotor skills was achieved. Over the next two years, however, a significant deterioration in both the knowledge of CPR and the ability to perform specific activities in practice was observed[12]. According to Zbigniew Żaba, head of the Rescue Medicine Department at the Poznan University of Medical Sciences, the level of knowledge gained during the training decreases after just 6 months[13].

Conclusions

The results of the described studies prove the key role of cyclical repetition of training courses in the discussed area of rescue operations because the proper administration of chest compressions is the most important element of CPR and has a direct influence on survival. The acquired knowledge and skills, therefore, require systematic consolidation and improvement, and frequent simulation training is a necessary condition for maintaining the required quality of resuscitation activities. Irregular and occasional training in the scope of basic elements, such as, for example, skills related to performing indirect heart massage, may turn out to be insufficient in the situation when a human life is being saved. In the case of the study results presented in this paper, despite the fact that the participants had the knowledge and skills required for the correct performance of their attempts, the introduction of additional elements, such as competition, or the pressure of judgement resulted in a situation where none of the two-person teams participating in the research obtained the expected effectiveness as regards the analysed parameters of the provided CPR. However, the studies were carried out only once, so it would be reasonable to repeat them, perhaps also taking into account performing the task in non-stress conditions, with the use of other stressors — incentives specific for the occupation, in changing circumstances and involving more participants, or also individual measurement of activities performed by each of them.

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[13] Krawczyk K, *op. cit.*

It would undoubtedly provide a more informed view on the rate of the correctness of resuscitation activities performed by paramedics from the Police Counterterrorist Subdivision, but only — unfortunately — from an academic point of view and scientific consideration on the subject. In practice, there is only one chance to save a life and incorrectly performed activities may result in a tragedy.

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About the Authors

***Waldemar Zubrzycki**, Professor of Social Sciences, a specialist in security sciences. Deputy Director of Police Central Investigation Bureau, Director of Bureau of Anti-Terrorist Operations, Deputy Director of Central Police Staff, Head of Special Training Department of Police Academy in Szczytno. Governor of Terrorism Prevention Division and Ministerial Adviser in Ministry of Interior and Administration; Head of the Permanent Expert Team of terrorism detection, counteraction and combating; Secretary of Interministerial Group for Terrorist Threats; Deputy Manager of Task Team for Elaboration of Detailed Assumptions for the Project of Terrorism Recognition, Prevention, and Elimination Act; Vice Chairman of Team in charge of the initiative implemented within the NATO-Russia Council, concerning cooperation in the field of aerial space use and aerial traffic management — Cooperative Airspace Initiative CAI; Expert in Working Party on Terrorism of European Union Council; Member of Committee of Experts on Terrorism (CODEXTER) of Council of Europe; Participant of sessions of the Interministerial Group for Proliferation Security Initiative (PSI); Member of Working Party on the Implementation of the Biological and Toxin Weapons Convention; Participant of sessions of the Joint Polish-American Working Group on Combating Terrorism; Member of the National Tactical Officers Association (Colorado, USA). CEPOL expert; Expert of NATO Science for Peace and Security Programme's Independent Scientific Evaluation Group; European Commission Expert in The EU Framework Programme for Research and Innovation Horizon 2020. E-mail: boa.01@wp.pl.*

***Jarosław Przyjemczak**, Capt., Doctor of Social Sciences in the discipline of security science. He obtained his doctoral degree in 2019 at the Police Academy in Szczytno. Assist. Prof. at the Department of Security of the Faculty of Law and Administration of the University of Business and Administration in Gdynia. In 1996 he graduated from the Medical Rescue Study Centre in Gdynia. A graduate of the Pedagogical Academy in Bydgoszcz and the Naval Academy in Gdynia, Department of Command and Naval Operations. Since 1996 he has been working in the Police, and since 1998 in the Counter-terrorist Subunit of the Police in Gdańsk. Participant in many domestic and foreign police and non-police training sessions and courses related to the subject of combating terrorism. He completed, among others a strategic course on counter-terrorism and terrorist threats, which was organised by the CEPOL Police College as part of EUROPOL in Bramshill, UK. Author of several publications. The organiser of the Paramedyk educational and training event, which has been held since 2008. A medical rescuer and qualified first aid rescuer, WOPR rescuer, MSWiA instructor diver, diving and shooting instructor, and scuba diver, authorised to manage underwater works of the Ministry of Internal Affairs and Administration. Since 2015, a lecturer associated with Police Academy in Szczytno. E-mail:jarek.przyjemczak@wp.pl.*

Beata Świeczko-Żurek, *holder of a post-doctoral degree, professor at the Gdańsk University of Technology, a researcher at the Faculty of Mechanical Engineering and Ship Technology, the head of the Department of Biomaterials Technology. For 16 years, she has been cooperating with doctors, researching and improving implants. Her interests are implants, mainly orthopedic ones — material selection, coatings used for implants, bone cement, nanometals and bacteria that lead to the degradation of the material in the human body. E-mail: beazurek@pg.edu.pl.*

***Streszczenie.** Zadania jakie realizują funkcjonariusze Policji wiążą się często z sytuacjami niebezpiecznymi, zagrażającymi życiu i zdrowiu osób w nich uczestniczących, samych policjantów, a także osób postronnych. Dotyczy to zwłaszcza jednostek policji antyterrorystycznej, których działania są skierowane przeciwko terrorystom i szczególnie niebezpiecznym przestępcom, a ich przebieg jest gwałtowny i agresywny. Z powodu braku fizycznej możliwości wprowadzenia w rejon działań cywilnych służb ratowniczych, rodzi to konieczność poszerzenia zespołu szturmowego o jeszcze jedną specjalizację — ratownika medycznego (combat paramedic), posiadającego odpowiednią wiedzę, umiejętności i kwalifikacje oraz wyposażenie umożliwiające samodzielne*

udzielanie pierwszej pomocy w trakcie prowadzenia działań. Przygotowanie ratownika medycznego musi być wszechstronne, kluczem zaś do skutecznego ratowania życia jest umiejętność wykonywania podstawowych czynności, w tym resuscytacji krążeniowo-oddechowej po rozpoznaniu nagłego zatrzymania krążenia. Celem niniejszej pracy jest przedstawienie wyników badań przeprowadzonych na dość unikatowej próbie badawczej, dotyczących skuteczności wykonywania pośredniego masażu serca przez ratowników medycznych jednostek specjalnych Policji oraz wniosków wynikających z badań empirycznych i ich porównania z wynikami podobnych badań, w odniesieniu do innych grup zawodowych. Wiedza i umiejętności nabyte podczas szkolenia szybko się dezaktualizują wymagając systematycznego utrwalania i doskonalenia. Dlatego też cykliczne powtarzanie ćwiczeń z zakresu działań ratowniczych odgrywa kluczową rolę w utrzymaniu niezbędnej jakości działań ratujących i podtrzymujących funkcje życiowe. Zebrany materiał może stanowić przesłankę do dalszych badań i wskazać ich potencjalne kierunki.

Zusammenfassung. *Die Aufgabenwahrnehmung von Polizeibeamten und -beamtinnen ist oft mit gefährlichen Situationen verbunden, die das Leben und die Gesundheit der beteiligten Personen, darunter der Polizisten und-innen selbst sowie der Umstehenden bedrohen können. Dies bezieht sich insbesondere auf Anti-Terror-Polizeieinheiten, deren Aktionen gegen Terroristen und besonders gefährliche Kriminelle gerichtet sind und deren Vorgehen gewalttätig und aggressiv ist. Da es nicht möglich ist, im Einsatzgebiet zivile Rettungsdienste einzusetzen, ist es notwendig, Angriffstruppen um eine weitere Spezialisierung zu erweitern, d. h. um einen Polizeisanitäter/-in, der/die über die entsprechenden Kenntnisse, Fähigkeiten und Qualifikationen sowie über die Ausrüstung verfügen würden, die eine eigenständige Leistung von Erster Hilfe während des Einsatzes ermöglicht. Die Vorbereitung eines Rettungssanitäters muss umfassend sein, aber der Schlüssel zur effektiven Lebensrettung ist die Fähigkeit, grundlegende Maßnahmen durchzuführen, einschließlich der Wiederbelebung nach dem Kreislaufstillstand. In diesem Beitrag werden die Ergebnisse einer Untersuchung vorgestellt, die an einer recht einzigartigen Stichprobe durchgeführt wurde und die Wirksamkeit der indirekten Herzmassage durch Sanitäter von Spezialeinheiten der Polizei zum Gegenstand hatte. Darüber hinaus werden die Schlussfolgerungen aus der empirischen Forschung mit den Ergebnissen ähnlicher Studien in Bezug auf andere Berufsgruppen verglichen. Die in der Ausbildung erworbenen Kenntnisse und Fähigkeiten veralten schnell und müssen systematisch vertieft und verbessert werden. Daher spielt die zyklische Wiederholung des Rettungstrainings eine Schlüsselrolle bei der Aufrechterhaltung der erforderlichen Qualität der lebensrettenden und lebenserhaltenden Maßnahmen. Das gesammelte Material kann als Grundlage für weitere Forschungen dienen und deren mögliche Richtung aufzeigen.*

Резюме. *Задания, выполняемые сотрудниками полиции, часто связаны с опасными ситуациями, угрожающими жизни и здоровью участвующих в них лиц, самих сотрудников полиции, а также посторонних свидетелей. Это относится, особенно, к антитеррористическим полицейским подразделениям, действия которых направлены против террористов и особо опасных преступников, а ход самих действий носит насильственный и агрессивный характер. В связи с отсутствием возможности размещения в районе проведения действий гражданских спасательных служб появляется необходимость расширить штурмовую группу еще одной специальностью — боевым парамедиком, обладающим соответствующими знаниями, навыками и умениями, а также имеющим оснащение, позволяющее самостоятельно оказывать первую помощь во время проведения действий. Подготовка парамедика должна быть всесторонней, а залогом успешного спасения жизни является умение выполнять основные действия, включая сердечно-легочную реанимацию после внезапной остановки сердца. Цель настоящей статьи — представить результаты исследований, проведенных на достаточно узкой исследовательской группе, по вопросу эффективности проведения непрямого массажа сердца парамедиками специальных полицейских подразделений, а также представить выводы, полученные в результате эмпирического исследования. Кроме того, Авторы сопоставляют полученные результаты с результатами аналогичных исследований, проведенных с участием представителей других профессиональных групп. Знания и навыки, полученные в ходе обучения быстро становятся устаревшими и требуют систематического закрепления и совершенствования. Поэтому регулярное повторение упражнений по спасательным действиям играет важнейшую роль в обеспечении необходимого качества спасательных действий. Собранные данные могут стать предпосылкой для дальнейших исследований и определить их возможные направления.*