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The ability to perform a post-traumatic examination as an indicator of the effects of teaching emergency medicine at the successive stages of the educational process: medical students, trainee physicians

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ABSTRACT

Introduction. Emergency management at the accident site is often of key importance for the later fate of patients who have sustained severe injuries. The scheme for post-traumatic examination has been developed to improve dealing with trauma patients.

Aim. The aim of this study was to analyse the effects of teaching emergency medicine to students and graduates of the Faculty of Medicine in Szczecin, on the basis of their ability to carry out post-traumatic examination. The skills at recognizing a direct threat to life and performing basic life-saving procedures were appraised.

Material and Methods. The study involved 81 individuals, who were evaluated three times at different stages of their educational process. Groups I and II comprised of fifth year students before and after an emergency medicine course, and group III consisted of trainee physicians. The Laerdal MegaCode Kelly manikin was employed in the project. Each of the simulated patients had the same external injury symptoms and parameters of vital functions.

Results. Evaluation of vital functions was correctly done by 14.8% of group I, 59.3% of group II, and no one in group III. A quick post-traumatic examination was performed properly by 11.2% of group I, 55.5% of group II, and no one in group III.

Conclusions. Group I lacked the ability to perform post-traumatic examination and first aid procedures. Participation in emergency medicine courses had positive effects on the participants' skills (group II). The ability of trainee physicians (group III) to perform the majority of the tested elements of post-traumatic examination, including first aid procedures, noticeably declined and reached the initial level.

Keywords: emergency medicine, post-traumatic examination, medical students, postgraduate trainee physicians, teaching effects.

Introduction

Implementation of the appropriate procedures for the management of trauma patients is an important element of healthcare workers' services. A shortening of the time spent by the emergency team on the spot of an accident is critical for survival of a patient, and necessary for the 'golden

hour' rule to be applied. In prehospital care, we can even talk about 'platinum ten minutes', during which the emergency team should identify patients, make diagnostic and therapeutic decisions, and start transport to hospital. Elements that reduce the time on the accident site include a properly performed examination of a patient, identification of all life-threatening injuries, and execution of procedures that save life and sustain vital functions. To improve the management of trauma patients, the scheme for post-traumatic examination has been developed, showing step by step how it should proceed and what emergency procedures should be involved. A fundamental part of post-traumatic examination is the monitoring of basic vital functions (consciousness, airway patency, breath, blood circulation). Therefore, its methodology not only makes it possible to verify the way of carrying out the post-traumatic examination, but also to test the ability to recognize a direct threat to life and perform basic life-saving procedures [1]. Medical skills in first aid and first aid from a qualified practitioner are crucial for giving aid in each situation of a direct threat to life, irrespective of whether it is caused by the consequences of an injury or a sudden cardiac arrest produced by other factors. All decisions must be then made very quickly, and so the skills needed must be well-learned and repeatedly practiced. A lack of them results in delayed recognition of respiratory and/or cardiac arrest, and the late onset of cardiopulmonary resuscitation. Each educational process should be thoroughly checked and evaluated, both during the process and after it, and the results of such evaluation should serve as a basis for drawing conclusions about the potential changes (for example, a teaching manner). Appraisal of the effects of teaching emergency medicine to medical students is a difficult task. It seems that the first instrument to determine the level of knowledge gained during studies and postgraduate residency training is the Physician Final Exam.

Aim

The aim of this study was to assess the effects of teaching emergency medicine to students and graduates of the Faculty of Medicine, the Pomeranian Medical University in Szczecin on the basis of their ability to carry out post-traumatic examination as an emergency procedure of choice. Versatility of this skill is the reason why it was used to verify the effects of the educational process. Since the monitoring of basic vital functions (consciousness, airway patency, breath, blood circulation) is a fundamental part of post-traumatic examination, we checked if the fifth year medical students and trainee physicians had the skills needed to identify an imminent threat to life, and whether they were able to perform basic life-saving procedures, just before the completion of their postgraduate residency training.

Material and Methods

The project involved 81 individuals, who were evaluated thrice at different stages of the educational process. The participants were denoted as group I, group II, and group III, depending on which stage they were evaluated. Group I consisted of fifth year students before starting the course in emergency medicine, group II included the same fifth year students after the completion of the course in emergency medicine, and group III comprised of trainee physicians — graduates of the Pomeranian Medical University in Szczecin who 2–2.5 years earlier were the members of groups I and II — being just before the completion of their postgraduate residency training. The study was to verify the ability of the participants to perform preliminary emergency management of a patient who has sustained numerous life-threatening injuries as a result of an accident. All participants were randomly assigned to one of four scenarios of the event. The simulated patients were: (1) a 25-year-old woman knocked down by a car, (2) a 30-year-old man battered with a baseball bat, (3) a 40-year-old man after a fall from the second floor, and (4) a 50-year-old woman after a fall from a height of six meters. The Laerdal MegaCode Kelly manikin was employed in the project. Despite different injury patterns, each of the simulated patients sustained the same injuries, resulting in identical external symptoms and the same parameters of vital functions in post-traumatic examination, namely unconsciousness and no reaction to stimuli (AVPU = U — *unresponsive*), the number of breaths per 10 seconds: 1 breath (6 breaths per 1 minute), pulse: 23 beats per 10 seconds

(140 beats per 1 minute), pulse wave perceptible on both the carotid and ulnar arteries, overfilled carotid veins, no respiratory murmur at the right side of the chest, a tympanic percussion note at the right side of the chest, pelvis unstable on palpation, the right shin fracture, and a laceration on the back. The participants' task was to perform a full post-traumatic examination according to the scheme, starting with the assessment of the accident site in terms of the threats posed to the emergency team, and evaluation of the mechanism of an injury. The next element was a preliminary examination of the patient's state, which included approaching an injured person and stabilizing his/her head with hands; assessing the level of consciousness according to the AVPU scale; restoring airway patency; measuring breath, and feeling the pulse. What was also taken into account was whether all components of post-traumatic examination were executed according to the following scheme: examination of the head, neck, chest, abdomen, pelvis, lower and upper limbs, and back. Furthermore, the participants were expected to identify injuries critical for the injured person's life. These included right-sided pneumothorax, unstable pelvic ring fracture, fractures of both right shin bones, and a laceration on the back. Another element gauged in this study was the provision of the patients with emergency medical treatment essential for their safety. Due to the type of injuries, it involved putting on a cervical collar to stabilize the cervical spine, the right oxygen therapy (active oxygen therapy with the use of a self-reinflating bag with a reservoir of oxygen) and maintenance of airway patency by means of mandibular protrusion and/or pharyngeal intubation, decompression of pneumothorax, and lifting patients on a separable-type scoop stretcher, putting patients on a spinal board, fastening patients to a spinal board with stabilizing belts, and putting on head stabilizers. These emergency procedures should be performed in the above-mentioned order. Attention was also paid to the execution of medical procedures regarded as unnecessary in the initial stage of giving aid, such as measuring blood pressure with a manometer, neurological examination beyond assessing the level of consciousness, preparation of the vascular access or intratracheal intubation. These procedures should be done at the successive stages of medical assistance. The results were statistically analyzed by means of Statistica PL version 10.0 (StatSoft Inc.), USA (2011) (www.statsoft.com., AXAP502C295820AR-K license). In this study we analyzed dichotomus qualitative (or discrete) variables. Differences between the groups expressed as a difference of fraction were analyzed using Pearson's chi-square test for independence, McNemar's test for paired data, and the fraction comparison test. The level of statistical significance was set at $p < 0.05$.

Results

The accident site was correctly assessed in terms of the emergency team's safety, the number of the injured individuals, and the need for additional means and forces by 15% of the participants in group I, 82% of those in group II, and 14% of those in group III ($P_{I–II;\ II–III} < 0.0001$; $P_{I–III}$ = n.s.). The procedure of approaching an injured person and stabilizing his/her head with hands was correctly performed by 11.2% of group I, 66.7% of group II and 7.2% of group III ($P_{I–II;\ II–III} < 0.0001$; $P_{I–III}$ = n.s.). The level of consciousness according to the AVPU scale was assessed by 92.5% of group I, 62.9% of group II, and 28.6% of group III ($P_{I–II;\ I–III;\ II–III} < 0.0001$). Restoration of airway patency was performed by 22.3% of group I, 96.3% of group II, and merely 14.2% of group III ($P_{I–II;\ II–III} < 0.0001$; $P_{I–III}$ = n.s.). Breath was correctly assessed by the majority of group I (92.6%), and all participants in groups II and III ($P_{I–II;\ I–III} < 0.05$; $P_{II–III}$ = n.s.). Feeling the pulse — which was the last stage of quick evaluation of basic vital functions — was correctly done by 59.3% of group I, 92.5% of group II, and 10.8% of group III ($P_{I–II;}\ P_{II–III;\ I–III} < 0.0001$). The assessment of all four elements — level of consciousness, airway patency, breath, and pulse — performed in the right order enables the monitoring of vital functions. In group I, all four elements were correctly assessed by 14.8% of the participants, three — by 44.4%, two — by 33.4%, and one — by 7.4%. Group II obtained better results: four elements were assessed by 59.3%, three — by 33.3%, and two — by 7.4%. None of the participants in this group assessed only one element. No one in group III assessed correctly all four elements (0%). Three elements were evaluated by 7.14% of the participants, two — by 39.29%, and one — by 53.57% ($P^{\chi 2}{}_{I–II;\ I–III;\ II–III} < 0.0001$).

Table 1 shows the proportions of the participants in all groups who performed particular elements of quick post-traumatic examination correctly. What all groups (especially I and III) found the most difficult was the examination of the neck and the back. Considering that it consists of eight elements, we can say that quick post-traumatic examination was correctly performed by 11.2% of group I, 55.5% of group II, and no one in group III ($P_{I-II; II-III} < 0.0001$; $P_{I-III} < 0.05$).

Table 2 shows the results of the execution of necessary emergency procedures performed due to sustained injuries. The parameters of vital functions and clinical symptoms in each of four scenarios were matched in such a way that the patients required the following necessary emergency medical procedures: (-) putting on a collar to stabilize the cervical spine; (-) oxygen therapy; (-) decompression of a right-sided pneumothorax; (-) carrying patients on a separable-type scoop stretcher; (-) putting patients on a spinal board, fastening them with belts, and immobilizing their heads with side stabilizers.

Discussion

The task of the participants at the successive stages of their educational process was to carry out a full scheme-based post-traumatic examination on a randomly chosen simulated patients, to recognize life-threatening states, and to perform necessary emergency procedures. Despite different injury patterns, each of the simulated patients had the same injuries, which resulted in identical parameters of vital functions and external symptoms in post-traumatic examination. Each of the simulated patients required the same emergency medical treatment. Age and sex of the patients had no influence on the course of the examination and interpretation of the results. In our study, 25 points of the scheme for post-traumatic examination were assessed. What was striking in the majority of the tested situations, was a statistically significant difference between the skills demonstrated by fifth year students before (group I) and after (group II) the emergency medicine course. Participation in

Table 1. The results of the execution of the successive elements of quick post-traumatic examination

No.	Examination	Group I	Group II	Group III	Statistical result $P^{\chi^2}_{I-II; I-III; II-III}$
1	Head	40.8%	88.9%	46.5%	$P_{I-II; II-III} < 0.0001$; P_{I-III} = n.s.
2	Neck	22.3%	81.5%	14.3%	$P_{I-II; II-III} < 0.0001$; P_{I-III} = n.s.
3	Chest	70.8%	100.0%	17.9%	$P_{I-II; II-III} < 0.0001$; P_{I-III} = n.s.
4	Abdomen	44.4%	100.0%	50.0%	$P_{I-II; II-III} < 0.0001$; P_{I-III} = n.s.
5	Pelvis	41.0%	100.0%	60.7%	$P_{I-II; II-III} < 0.0001$; P_{I-III} = n.s.
6	Lower limbs	51.9%	100.0%	55.6%	$P_{I-II; II-III} < 0.0001$; P_{I-III} = n.s.
7	Upper limbs	22.6%	100.0%	37.1%	$P_{I-II; II-III} < 0.0001$; P_{I-III} = n.s.
8	Back	11.2%	55.5%	0.0%	$P_{I-II; II-III} < 0.0001$; $P_{I-III} < 0.05$
The mean proportion of the physicians who performed all elements of post-traumatic examination		39.9%	90.7%	35.7%	$P_{I-II; II-II; I-III} < 0.0001$

Table 2. Emergency medical treatment essential for the patient's safety

No.	Emergency medical treatment	Group I	Group II	Group III	Statistical result $P^{\chi^2}_{I-II; I-III; II-III}$
1	A collar stabilizing the cervical spine	81.4%	88.8%	89.0%	$P_{I-II; II-III; I-III}$ = n.s.
2	Active oxygen therapy and maintenance of the upper airway patency	48.0%	100.0%	71.5%	$P_{I-II; II-III} < 0.0001$; $P_{I-III} < 0.05$
3	Decompression of a right-sided pneumothorax	33.4%	92.6%	39.3%	$P_{I-II; II-III} < 0.0001$; P_{I-III} = n.s.
4	Using a separable-type scoop stretcher	41.0%	100.0%	60.7%	$P_{I-II; II-III} < 0.0001$; P_{I-III} = n.s.
5	Putting patients on a spinal board, fastening them with stabilizing belts, and immobilizing their heads with side stabilizers	59.2%	100.0%	75.0%	$P_{I-II; II-III} < 0.0001$; P_{I-III} = n.s.
6	Procedures regarded as unnecessary in the initial stage of giving aid	59.2%	22.2%	75.0%	$P_{I-II; II-III} < 0.0001$; P_{I-III} = n.s.

this course increased the proportion of students who performed post-traumatic examination and assessed basic vital functions correctly. The data concerning group II are similar to those obtained by Skitek et al. in Poznań [2]. The comparison of groups I and II with group III (trainee physicians) revealed that after two years, the ability to perform the majority of the tested elements of post-traumatic examination substantially and statistically significantly declined, reaching again the level noted in group I. The same observation was also made about the ability to perform first aid procedures, consecutive elements of post-traumatic examination, and emergency medical treatment essential for the patient's safety. The results presented and discussed in our study confirm the effectiveness of teaching practical skills in the field of post-traumatic examination. The scheme for post-traumatic examination and practical skills were taught during the emergency medicine course, therefore good results achieved by group II are not surprising for us. An especially worrying aspect is trainee physicians' performance on quick post-traumatic examination just before the completion of a postgraduate residency training program (group III). In this group, many participants made critical mistakes from the point of view of emergency management efficiency. If underlying elements of post-traumatic examination are neglected or performed incorrectly, the results can include improper examination of a patient, false conclusions drawn from the data, and not undertaking essential medical life-saving procedures.

These findings are supported by the study of Dąbrowski et al., who analyzed a population of 72 fourth year medical students of Poznań Medical University and 82 trainee physicians — graduates of this university. Although the study only tested theoretical knowledge (single choice questionnaire), the results obtained were highly unsatisfactory [3].

When starting our research, we could expect that in all three groups, comprised of the same individuals at various stages of the educational process, the knowledge and skills needed to carry out post-traumatic examination will only improve. This assumption seemed even more certain, as the participants continued their education in the sixth year of their studies, and then completed one-year of postgraduate residency training over the whole time of our research. What is more, participation in our project was not a new experience for the individuals in group III, because they had already performed post-traumatic examination as the members of groups I and II. And yet, our expectations have been thwarted. The fact that simulated events took place in a classroom, and an injured person was represented by a manikin may have influenced the participants' attitude to the task. On the other hand, the worldwide teaching of emergency medicine is based on training on technically advanced manikins in simulation laboratories. Medical simulations, which reconstruct a specific physiological process complicated by a disease or an injury, are modern teaching methods. The simulation scenario is decided by the type of complication. The role of a patient is played by a manikin on which all procedures can be performed that are normally executed on a living person. Simulation is thus not only a method of learning, but most of all the way of checking on the ability to provide emergency treatment with no harm to the patient if the procedure is performed incorrectly [4]. Common application of simulators in training programs was preceded by the period of using various types of manikins in the objective system of clinical exams (OSCE) [5]. According to Ali et al. high-quality simulators can substitute for human beings as models of injured people [6]. Taking into account a wide variety of medical procedures — resulting from preliminary diagnosis and post-traumatic examination — that can be trained on simulators, it is difficult to overestimate their role [7–10]. It is probable that those who have not performed medical procedures on manikins during their education, will not perform them in their professional duties either.

Based on our research, we found that neither the number of didactic hours of emergency medicine for medical students, nor the teaching manner are sufficient to achieve educational goals. Postgraduate residency training does not give a guarantee of success either. Both the organization of a didactic process during medical studies, and the form of a postgraduate residency training program require new solutions. To improve the situation, emergency medicine classes for medical students should be divided into competency levels, and conducted at various stages of studies. Students and trainee physicians, during their postgraduate residency training, should

take part in refresher courses in the field of basic and advanced resuscitation techniques used on adults and children [3]. The sense of organizing the training in the field of post-traumatic examination in that way in order to achieve good educational effects is confirmed by the study of Li and Jawaid. An extension of the training program with an additional course, refreshing the previously-taught contents, noticeably improves both theoretical and practical exam results [11, 12]. Nevertheless, according to Grześkowiak et al. even physicians specializing in anesthesiology and intensive therapy have inadequate resuscitation skills, despite the fact that resident physicians take part in refresher courses. This shows that we are still far from normality [13].

Conclusions

1. Fifth year students starting the emergency medicine course (group I) were unable to perform post-traumatic examination and so called first aid procedures correctly.
2. Participation in the emergency medicine course improved the proportion of the procedures performed correctly (group II).
3. The ability of trainee physicians (group III) to perform the majority of the tested elements of a post-traumatic examination, including so called first aid procedures, noticeably declined and returned to the initial level.

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Conflict of interest statement
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