Training Effects of Trauma Courses with Regards to the Pre-Hospital Treatment of Spinal Trauma

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Abstract

Background: Prehospital assessment and treatment of spinal injuries include rapid and valid decision making about the necessity of immobilization, sound knowledge of the evaluation of the accident's kinematics, the examination of the spine and the various methods of immobilization.

The aim of the current study was to analyze the subjective uncertainty of paramedics in terms of the pre-hospital evaluation and treatment of potential spinal injuries before and after participating at a Pre-Hospital Trauma Life Support (PHTLS) course.

Methods: In a time period of 17 months, participants of PHTLS courses were asked to complete a questionnaire directly before and after participation at a PHTLS course.

Results: Among the 465 participants, there was a significant increase in confidence after participation at the PHTLS course when asked about including kinematics in possible injury patterns of the spine (p < 0.001) as well as deciding on certain extrication methods (p < 0.001). Furthermore, confidence significantly increased when asked about pre-hospital diagnosis (p < 0.001) and treatment of potential spinal injuries (p < 0.001) in general.

Conclusion: Participation at a PHTLS course was able to strengthen the subjective feeling of confidence in the prehospital treatment of spinal injuries.

Keywords: cervical collar; immobilization; questionnaire; training; self-assessment

Introduction

It is a great challenge for emergency medical care providers all over the world to recognize all life-threatening injuries and to decide about treatment priorities in multiple injured patients [1]. In order to cope with this challenge, the treatment of multiple injured patients should be as structured as possible [2]. There are various different courses available in Germany and all over the world (ATLS PHTLS, ITLS, Traumamanagement) which teach the structured evaluation and treatment of trauma patients. The structured treatment’s focus is on removing the acute vital threats from the patient [2]. Afterwards, severe accompanying injuries are also addressed. One of these are spinal injuries, which are involved in around one
third of cases of multiple injured patients [3]. About 7.5% of these patients have an accompanying injury to the spinal cord [4] with serious and extensive consequences for the patient. Immobilization of the cervical spine or the entire spine to avoid secondary damage has been a standard procedure in pre-hospital emergency medicine for many years [5, 6].

Current scientific literature discusses the necessity for immobilization in trauma patients in general and the advantages of various different immobilization methods in particular in an increasingly controversial manner [6–9]. This discussion is based on the increasing awareness that spinal immobilization can also be associated with severe complications such as restrictive limitations on lung function even in uninjured healthy test subjects [10,11]. Furthermore, a cervical collar which is attached as part of a full-body immobilization can also make airway management significantly more difficult [12]. Intracranial pressure can also be increased significantly by placing a cervical collar on the patient [13,14]. In case of severe injuries of the upper cervical spine, the dural sac is compressed during the application of a cervical collar [15]. Thus, in particular patients (e.g. those with Bechterew’s disease), simply placing a cervical collar on the patient can increase neurological symptoms [16, 17].

The possible complications mentioned before may indicate that immobilization of the spine should not be carried out routinely but rather only where it is indicated, which is also recommended by current guidelines of trauma care [18–29] and current immobilization protocols [21–23]. In order to be able to make a rapid and valid decision about the necessity of immobilization, sound knowledge of the evaluation of the accident’s kinematics, the examination of the patient’s spine and the various methods of immobilization are necessary.

The aim of the current study was to analyze the subjective uncertainty of paramedics in terms of the pre-hospital evaluation and treatment of potential spinal injuries before and after participating at a PHTLS course.

**Methods**

Since the participants on the current study were participants at PHTLS courses but no patients, no consent to participate is needed according to German law. This and the study as a whole have been approved by the competent ethical committee (Ethics Committee of the State Medical Association of Rhineland-Palatinate, Mainz, Germany) under the file number 837.371.13 (9056).

The study period was from April 2013 to August 2014. In this time period, participants at PHTLS courses [2] were asked to complete a standardized anonymous questionnaire containing the questions summarized in Figure 1 and Figure 2. The questionnaire was answered directly before the start of the PHTLS course (course day 1; around 8 am) and directly after the participation at the PHTLS course (course day 2; around 5 pm).

The questionnaire was developed by an interprofessional team consisting of medical doctors, medical educators and a sociologist with high experience in the development of questionnaires. Based on the experience of this expert panel and of an unstructured literature search, the current questionnaire was developed. An English version of the questionnaire is available as an additional file.

The main idea when formulating the items of the questionnaire and the major concern when constructing the rating-scale was the uniqueness of the statement and of positioning the answer. Thus, the rating was based on a Likert scale as described before [24]. A seven-point Likert scale rating-scale ranging from -3 (does not apply at all) through 0 (neutral) to +3 (applies completely) was used to avoid ceiling or floor effects. Questionnaires based on such a Likert scale have been used by the authors in another study [25]. The questionnaire used in the current study has also been used in a survey among 333 emergency physicians [26].

Sample size calculation based on a power of 90% resulted in 231 participants. Due to many possible response biases, we doubled the number on a minimum of 462 questionnaires.

Data analysis was conducted using SPSS Statistics 22.0 (IBM Corp, Armonk, NY, USA).

The seven-point rating-scale mentioned above was shifted to a scale from 1 (does not apply at all) to 7 (applies completely). This can be treated as a quasi-metric interval scale and parametric statistical methods can be applied.
in the analysis of the data. Therefore, distributional parameters like arithmetic means, standard deviations and ranges were used for the description of the results. The t-test for two related samples (before participation at a PHTLS course vs. after participation at a PHTLS course) was used to verify whether or not the mean pairwise differences are significantly different from zero. Because of the relatively large sample sizes within the groups the normality assumption for the pairwise differences can be neglected (robustness of t-test [27]). A p-value < 0.05 was considered to be statistically significant. The figures show the corresponding mean values ± standard deviations.

Figure 1: Participants’ answers in terms of uncertainty of the pre-hospital diagnosis and treatment of potential spinal injuries before and after participation at a PHTLS course.
Due to incomplete data sets different numbers (n) of participants may occur in the analysis of the different questions.

**Results**

A total of 468 paramedics have been asked to take part in the survey. Three paramedics refused to take part in the survey. Thus, a total of 465 paramedics (male: 85.2%; n = 464) with an average age of 32.4 ± 8.6 years (range: 20–60; n = 463) responded to the survey (response rate: 99.4%). The respondents indicated that they had an average of 2.4 ± 2.2 training sessions on immobilization per year (range: 0–9 training sessions on immobilization per year; n = 447).

The assessment of the question about uncertainty with including kinematics in possible injury patterns of the spine was answered in a neutral manner before participation at a PHTLS course (Figure 1). The question about uncertainty when deciding on an extrication method was also answered in a neutral manner before participation at a PHTLS course (Figure 1). There was a significant (p < 0.001) increase in confidence after participation in the PHTLS course for both questions
(Figure 1). Even before attending at a PHTLS course, the respondents said they did not feel uncertain about the pre-hospital diagnosis and treatment of potential spinal injuries (Figure 1). But the subjective confidence increased as a result of participation at the PHTLS course for all of the questions (Figure 1). Confidence about the correct positioning of a cervical collar also increased as a result of attending a PHTLS course (Figure 1).

Before participation in the PHTLS course, the participants indicated that standardized treatment processes improve working with a team approach (Figure 2). The PHTLS course was able to increase this perspective significantly (p < 0.01; Figure 2).

The statement that there is a requirement for a simple protocol for the standardized pre-hospital treatment of potential spinal injuries found wide approval even before attending a PHTLS course (Figure 2). After participation at the PHTLS course approval for this statement increased significantly (p < 0.001; Figure 2).

The vast majority of those surveyed indicated that they already knew a protocol for the standardized pre-hospital treatment of potential spinal injuries before participation at the PHTLS course (Figure 2). Participation at the PHTLS course led to a significant (p < 0.001) increase in the number of participators agreeing with this statement (Figure 2).

**Discussion**

By surveying 465 paramedics, this survey was able to show that the study participants do not report to feel uncertain about the pre-hospital diagnosis and treatment of potential spinal injuries. However, this subjective feeling of confidence was able to be improved significantly by participation at a PHTLS course in all requested areas. The participants agreed with the statement that structured instructions facilitate working in a team of emergency medical care providers. Furthermore, there seems to be a need for a new structured protocol for the pre-hospital treatment of potential spinal injuries, even though such protocols are already known to the study participants.

The high subjective feeling of confidence indicated by the participants in terms of trauma care in general corresponds to the results of a survey of German paramedics from 2014 in which around 80% of paramedics stated that they felt well trained [28]. However, in the current study, the subjective confidence was able to be improved significantly by participation at a PHTLS course in all of the requested areas. The positive learning effects achieved by structured course formats about trauma care were described multiple times [29,30]. PHTLS courses were also able to balance out deficiencies in terms of training [28]. Further questions still need to be asked to determine whether the subjective self-assessment of the feeling of confidence corresponds to the practical skills. In a current study a correlation between self-assessment of paramedics and the correct positioning of a cervical collar was not able to be shown [25].

The PHTLS courses at that time focus on the analysis of the forces acting on the patient as these considerations of kinematics can also give an indication of potential spinal injuries [22,31,32]. The participants at a PHTLS course repeatedly practiced this analysis of kinematics during the course. This may be the cause of the considerable improvement in subjective confidence in the interpretation of kinematics with regard to potential spinal injuries that has been shown in the current study. The focus of the PHTLS courses is also placed on the indication of the extrication method and the clinical examination of the spine. In these areas, considerable improvements in perceived confidence were able to be demonstrated as a result of participation at a PHTLS course. To date, the indication for spinal immobilization and the practical skill of placing a cervical collar on a patient were not clearly defined learning objectives of PHTLS courses. There was a significant increase in subjective confidence, but on the basis of the evaluation of this study the learning objectives in the new, eighth edition of PHTLS were adapted towards more training in application of a cervical collar and indication for spinal immobilization.

Structured options in terms of the assessment and treatment of trauma patients were taught during the PHTLS courses [2]. The course participants surveyed indicated that these structured treatment processes could facilitate teamwork. It remains questionable if these structures treatment processes will always be used in the daily routine [33]. In order to further disseminate structured trauma care, numerous international course
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systems are offered and are also being included in the training of medical students [34].

Structured protocols are also described for the indication of the spinal immobilization [22,35], and the course participants were aware of these even before participating at the PHTLS course. However, the course participants highlighted the need for a simple protocol for the pre-hospital treatment of potential spinal injuries. This requirement increased significantly as a result of participation at the PHTLS course. Based on the current study, a new immobilization protocol that takes the current patient’s status into account and that is based on the well-known ABCDE-approach of trauma care was developed and established [21].

The current study is limited to some extent. In every survey that is based on a questionnaire, different response biases may occur. In the current study, an anonymized questionnaire has been used for reducing Social-Desirability-Response-Bias. In order to allow an open answer (zero), an uneven number of answer items have been used. However, this may contribute to an error of central tendency that also may bias the study. Thus, different response biases may restrict the predications of the current study in spite of the high number of study participants.

Although questionnaires with Likert scales are frequently used in comparable surveys [25,26], the current questionnaire has not been validated towards truly measuring the participant’s confidence. Furthermore, the reliability of the answers from the repeated survey after participating at a PHTLS course was not analyzed.

Implementing a control group that did not participate at a PHTLS course but has been surveyed a second time could indicate the reliability of the repeated survey. Thus, the results of the current study should be interpreted thoroughly.

Conclusion

The current study was able to show that German paramedics predominantly do not feel uncertain about the pre-hospital diagnosis and treatment of potential spinal injuries. However, participation at a PHTLS course was able to additionally strengthen this subjective feeling of confidence.

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Authors’ Contributions

AG, SG, BG, DH, PAG and MKr conceived the study and designed the trial. AG, BG, PAG and MKr supervised the conduct of the trial and data collection. SG and DH, MKü managed the data, including quality control. MKü and VP provided statistical advice on study design and analyzed the data. AG and MKr drafted the manuscript, and all authors contributed substantially to its revision. MKr and AG take responsibility for the paper as a whole. All authors have read and approved the manuscript in its current version.

Competing Interest

SG and DH are PHTLS instructors.

Availability of Data and Material

All data generated or analysed during this study are included in this published article.

References

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