Evaluation of Pre-Hospital Healthcare Personnel's Knowledge and Experience Levels About Prone CPR: A Survey Study

Hastane Öncesi Sağlık Personelinin Pron Kardiyo Pulmoner Resüsitasyon Hakkında Bilgi Düzeyinin Değerlendirilmesi

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ABSTRACT

Aim: Prone cardiopulmonary resuscitation (CPR) (CPR performed in the prone position) is an important intervention for managing cardiopulmonary arrest in patients that experience cardiopulmonary arrest in the prone position. It is important for pre-hospital healthcare personnel to learn and practice this technique when necessary. This study aims to determine the knowledge level of pre-hospital healthcare personnel on prone CPR.

Material and Methods: Our study is a cross-sectional survey study conducted at a single center. Pre-hospital healthcare personnel who transferred patients by ambulance to Ankara City Hospital between July 1-31, 2021, were included in the study. Participants were given a total of 31 questions, 24 of which aimed to determine demographic information and educational status, and 7 of which assessed theoretical knowledge about prone CPR.

Results: A total of 99 pre-hospital healthcare personnel participated in the study. The average age of the participants was 32 ± 5 (Mean$\pm$SD). Examination of the responses revealed that half of the participants (n=45, 45.5%) had transported patients in the prone position, yet the majority had not received any training on prone CPR (n=73, 73.7%) and had never performed prone CPR (n=88, 88.9%). Participants' knowledge levels were low about prone CPR, with a mean total correct answer rate of 3 ± 1 (Mean$\pm$SD) out of 7 questions, median of 3 (0-6) (min-max). Mean and median number of total correct answers were compared according to participants' gender, prone CPR training status, years of experience, previous experience in prone CPR, the school of graduation, professional title, guideline reading status, routine CPR training status. No statistically significant difference was found between the groups.

Conclusion: We observed that healthcare personnel working in pre-hospital ambulance services do not have sufficient knowledge or training about prone CPR. Since pre-hospital healthcare personnel may encounter prone CPR, there is a need for training on performing prone CPR in this group.

Keywords: Prone CPR, reverse CPR, prehospital

ÖZ

Amaç: Pron kardiyopulmoner resüsitasyon (KPR) (yüzüstü pozisyonda yapılan KPR), yüzüstü pozisyonda kardiyopulmoner arrest olan hastaların yönetiminde önemli bir müdahaledir. Bu tekniğin öğrenilmesi ve gerektiğinde uygulanması, hastane öncesi sağlık personeli için önemlidir. Bu çalışmanın amacı, hastane öncesi sağlık personelinin pron KPR konusundaki bilgi düzeylerini belirlemektir.

Gereç ve Yöntemler: Çalışmamız tek merkezde yürütülen kesitsel bir anket çalışmasıdır. 1-31 Temmuz 2021 tarihleri arasında Ankara Şehir Hastanesine ambulansla hasta nakleden hastane öncesi sağlık personeli çalışmaya dâhil edilmiştir. Katılımcılara 24'ü demografik bilgi ve eğitim durumunu belirlemeyi, 7'si ise pron KPR konusundaki teorik bilgiyi değerlendirmeyi amaçlayan toplam 31 soru yöneltilmiştir.

Bulgular: Çalışmaya toplam 99 hastane öncesi sağlık personeli katılmıştır. Katılımcıların ortalama yaşı 32 ± 5 (Ort$\pm$SS) idi. Yanıtlar incelendiğinde, katılımcıların yarısının (n=45, %45,5) en az bir kez pron pozisyonda hasta taşıdığı, ancak çoğunluğun pron KPR konusunda eğitim almadığı (n=73, %73,7) ve hiç pron KPR uygulamadığı (n=88, %88,9) tespit edildi. Katılımcıların pron KPR konusundaki bilgi düzeyleri düşüktü; 7 soru üzerinden ortalama toplam doğru yanıt oranı 3 ± 1 (Ort$\pm$SS), medyan 3 (0-6) (min-maks) idi. Katılımcıların cinsiyet, pron KPR eğitim durumu, mesleki deneyim yılı, daha önceki pron KPR deneyimi, mezun olduğu okul, mesleki unvan, rehber okuma durumu, rutin KPR eğitim durumu gibi değişkenlere göre ortalama ve medyan toplam doğru yanıt sayıları karşılaştırıldı. Gruplar arasında istatistiksel olarak anlamlı bir fark bulunamadı.

Sonuç: Hastane öncesi ambulans hizmetlerinde çalışan sağlık personelinin pron KPR konusunda yeterli bilgiye veya eğitime sahip olmadığını gözlemledik. Hastane öncesi sağlık personeli pron KPR ile karşılaşabileceğinden, bu grup için pron KPR uygulama eğitimi gerekmektedir.

Anahtar Kelimeler: Pron KPR, yüzüstü KPR, hastane öncesi

Introduction

The prone position is generally used in the operating room to facilitate access to the surgical area and in the intensive care units (ICU) to improve oxygenation in patients with severe hypoxic respiratory failure. During the coronavirus disease 2019 (COVID-19) pandemic, this position has been widely used in both spontaneously breathing and mechanically ventilated patients with acute respiratory failure (1). The application of the prone position in intubated or non-intubated patients with COVID infection and lung involvement has shown positive effects on hypoxia (2). "Prone CPR", also referred to as "Reverse-CPR", is defined as CPR performed in the prone position.

If a patient experiences cardiopulmonary arrest while monitored in the prone position, it takes approximately 5-6 people and up to 3 minutes to turn the patient from prone position to supine position and initiate cardiopulmonary resuscitation (CPR) (3). This delays the start of chest compressions. Additionally, attempting to turn the patient to the supine position can dislodge critical lines, detach monitoring equipment cables, or the endotracheal tube of a critically ill patient. Attempting to turn the patient to the supine position without adequate number of people can pose a risk to both the patient and the healthcare personnel. Delays in chest compressions and defibrillation can negatively impact patient outcomes (4,5). The American Heart Association (AHA) Guidelines for CPR and Emergency Cardiovascular Care recommends that CPR in the prone position might be reasonable when the patient cannot be placed in the supine position, particularly in hospitalized patients with an advanced airway in place (6).

Prone CPR is also an important skill for pre-hospital healthcare personnel. The aim of this study is to determine the knowledge levels of pre-hospital healthcare personnel on prone CPR and whether they have applied this method on their patients in their daily practice.

Material and Methods

This study is a single-center, cross-sectional, observational survey study. Surveys were administered to pre-hospital healthcare personnel who brought patients to Ankara City Hospital by 112 emergency ambulance system between July 1-31, 2021. The hospital where the study was conducted is a city hospital that accepts approximately 250-300 ambulance cases daily, serving a population of 2.5 million. The hospital has 700 intensive care beds and handles secondary transfers to intensive care units from other hospitals by ambulance. Ethical approval was obtained from the Ankara City Hospital Ethics Committee with decision number E-2-21-559.

A 31-question survey was administered to participants who brought patients to the emergency department by ambulance after they handed over their patients. The survey included 24 questions about the participants' demographic characteristics (age, gender, educational status, professional title), professional training in CPR, and the guidelines they had read, as well as 7 multiple-choice questions assessing their theoretical knowledge of prone CPR. The survey form was created through Google Forms and was electronically delivered to the participants. Informed consent was obtained from the participants via the same platform.

Participants were prevented from giving more than one answer to the same question on the Google Forms platform. Inclusion criteria for the study: Pre-hospital healthcare personnel working in Ankara 112 emergency ambulance services and bringing patients to Ankara City Hospital by ambulance.

The exclusion criteria for the study is as follows: refusal to participate in the survey and failure to answer all survey questions.

Statistical Methods

IBM SPSS Statistics Version 16 was used to evaluate the survey results. Frequency distributions were provided for categorical variables, and descriptive statistics were given for continuous variables. The Shapiro-Wilk normality test was applied for continuous variables. For comparisons of medians between two independent groups where the normality assumption was not met (p<0.05), the non-parametric Mann-Whitney U test was used. For comparisons of means between two groups with normally distributed data, the Independent Samples t-test was used. The Chi-square test was applied for ratio comparisons of independent frequency data. A significance level of p<0.05 was used for statistical significance.

Results

A total of 105 pre-hospital healthcare personnel working in ambulances participated in the study. 6 surveys were excluded because they were incomplete. 99 surveys were included in statistical analysis. The average age of the participants was 32±5 (Mean±SD), with a median age of 33 (min-max 21-45). The demographic data of the participants are presented in Table 1.

Total number of participants (n=99)		n (%)
Gender, male		43 (43.4)
Education level	High school	8 (8.1)
	Two Year Degree	37 (37.4)
	Bachelor's Degree	48 (48.5)
	Master's Degree	6 (6.1)
Professional title	Emergency Medical Technician	40 (40.4)
	Paramedic	54 (54.5)
	Nurse	5 (5.1)
Graduation Year	2000-2005	16 (16.2)
	2006-2010	28 (28.3)
	2011-2015	20 (20.2)
	2016-2020	25 (25.3)
	2021-..	10 (10.1)
Years of work experience	0-5	22 (22.2)
	6-10	38 (38.4)
	11-	39 (39.4)
Timing of prone CPR training	Never received training	73 (73.7)
	After starting to work	18 (18.2)
	In high school	1 (1.0)
	In university	7 (7.1)

Table 1. Demographic data of participants
CPR: Cardiopulmonary resuscitation

Question	Answer	n (%)
Did you receive certified routine CPR training?	Yes	54 (54.5)
	No	45 (45.5)
Did you receive prone CPR training?	Yes	26 (26.3)
	No	73 (73.7)
Do you read current Resuscitation Guidelines?	Yes	30 (30.3)
	No	69 (69.7)
Did you ever transport COVID-19 positive patients?	Yes	91 (91.9)
	No	8 (8.1)
Have you ever transported a patient in the prone position?	Yes	45 (45.5)
	No	54 (54.5)
Have you ever performed Prone CPR?	Yes	11 (11.1)
	No	88 (88.9)

Table 2: Participants' answer about CPR and prone CPR
CPR: Cardiopulmonary Resuscitation.

		n (%)
If a prone patient experiences cardiopulmonary arrest, in which position is CPR performed?	Prone (correct)	37 (37.4)
	Supine (false)	62 (62.6)
Is prone CPR applied to a patient without an advanced airway?	Yes (correct)	51 (51.5)
	No (false)	48 (48.5)
On which vertebrae should the hands be placed during prone CPR?	T1-T4 (false)	7 (7.1)
	T4-T7 (false)	68 (68.7)
	T7-T10 (correct)	24 (24.2)
How many compressions in a minute should be performed in prone CPR?	100-120 (correct)	43 (43.4)
	120-140 (false)	11 (11.1)
	80-100 (false)	45 (45.5)
Can prone CPR be performed on children?	Yes (correct)	57 (57.6)
	No (false)	42 (42.4)
Where should defibrillator pads be placed during prone CPR?	All of the positions described below (correct)	35 (35.4)
	Only front-back (false)	20 (20.2)
	Only between vertebral column and the right scapula-the axilla (false)	44 (44.4)
Can End-tidal CO_2 be measured during prone CPR?	Yes (correct)	82 (82.8)
	No (false)	17 (17.2)

Table 3. Answers to the Questions Assessing Their Knowledge Levels
CPR: Cardiopulmonary resuscitation

The ratio of participants who transported COVID-positive patients, received prone CPR training, read guidelines, received certified routine CPR training, transported patients in the prone position, and performing prone CPR are presented in Table 2.

Participants were asked 7 questions to assess their knowledge level regarding prone CPR. The ratio of correct and incorrect answers for each question are shown in the table 3.

2% of participants (n=2) did not answer any questions correctly. 6.1% of participants (n=6) answered 1, 16.2% (n=16) answered 2, 28.3% (n=28) answered 3, 30.3% (n=30) answered 4, 15.2% (n=15) answered 5, and 2% (n=2) answered 6 questions correctly. No participant answered all 7 questions correctly (n=0). The average number of correct answers was calculated as 3±1 (Mean±SD), with a median of 3 (0-6) (min-max).

Table 4 presents a comparison of participants' gender, prone CPR training status, average years of experience, whether they have previously performed prone CPR, the school they graduated from, professional title, guideline reading status, routine CPR training status, and the mean and median number of correct answers. No statistically significant difference was found between the groups.

Discussion

Cardiac arrest occurring in prone positioned patients may slightly increase the complexity of the procedures, with additional pitfalls (7). Rapid defibrillation, along with early and uninterrupted chest compressions, is crucial for the return of spontaneous circulation in cardiac arrest patients. Prone CPR shortens the time to start CPR for patients that are already in the prone position, thereby reducing the no-flow time. In the literature, this technique is recommended to avoid delays, especially in situations where it is not easy to turn patients to the supine position (8). In 2001, Brown et al. published a review on prone CPR (9). In 2003, Mazer et al. demonstrated that prone CPR during cardiac arrest produced higher systolic and mean arterial pressures compared to standard CPR (10). H-W's study also found that although physicians rarely encountered prone CPR, the outcomes were positive (11).

Prone CPR is also included in the AHA and European Resuscitation Council (ERC) guidelines (7). When performing prone CPR, hands should be placed over the T7-T10 vertebrae, and a firm surface should be present under the patient (12). The rate of chest compressions should be 100-120 per minute, with a depth of 5-6 cm, allowing for full recoil, like routine CPR (12). Defibrillation pads can be placed under both armpits or on the left mid-axillary line and right scapula (3,13).

		Total number of correct answers		Mann Whitney-U test p value
		Mean±SD	Median (Min-max)	
Prone CPR training status	Yes	3±1	4 (0-5)	0.749
	No	3±1	3 (0-6)	
Years of experience	0-5	3 ±1	3 (1-5)	
	6-10	3 ±1	3 (0-6)	0.360
	11-	4 ±1	4 (1-6)	
Have you ever performed prone CPR?	Yes	4±1	4 (2-6)	0.067
	No	3±1	3 (0-6)	
Education level	Bachelor's Degree	3±2	4 (0-6)	
	High School	4±1	4 (3-5)	0.685*
	Two-year degree	3±1	3 (1-5)	
	Master's Degree	3±1	3 (1-5)	
Professional title	Emergency Medical Technician	3±1	4 (0-6)	
	Paramedic	3±1	3 (0-5)	0.783*
	Nurse	3±0	3 (3-4)	
Guideline reading status	Yes	4±1	4 (0-5)	0.277
	No	3±1	3 (0-5)	
Routine certified CPR training status	Yes	4±1	4 (0-6)	0.088
	No	3±1	3 (1-5)	
Gender	Male	4±1	4 (1-6)	0.167
	Female	3±1	3 (0-6)	

Table 4. Comparison of gender, prone CPR training, average years of experience, prone CPR performance, Sschool graduated from, professional title, guideline reading status, routine CPR training, and number of correct answers

CPR: Cardiopulmonary resuscitation. * Kruskall-wallis test.

The risk of respiratory transmission, which has become more significant during the COVID-19 pandemic, is theoretically lower with prone CPR as the rescuer is not face-to-face with the patient. Prone CPR, performed only with hands in the field, contributes somewhat to air exchange, making it a good alternative for rescuers who avoid mouth-to-mouth ventilation (14).

In their study Erdur et al. observed that that most of the physicians had not received post-graduation training on emergencies amongst general practitioners working in emergency services in Denizli (15). Likewise, in our study, the participation rate in certified training programs on routine CPR was found to be 45.5%. These finding indicate the need for more training on routine CPR in our country.

In a study related to supine CPR by Kayıpmaz et al. faculty of dentistry school students received CPR training, and it was observed that the number of compressions per minute, the ratio of correct compressions to total compressions, and compression percentages significantly improved positively with the training (16). In a study Martinez et al investigated the knowledge level of supine CPR among physicians in the internal medicine department and similar results were obtained. They emphasized the insufficient knowledge level of doctors regarding routine CPR and noted that this knowledge level did not vary with years of experience or relevant training (17). Similarly, no relationship was found in our study between the participants' professional titles, years of experience, and the number of correct answers.

Between participants who received prone CPR training and those who did not, no significant difference was found regarding mean number of correct answers. This could be due to the small number of prone CPR knowledge questions

and the fact that some of the questions could be answered with knowledge of routine CPR.

70% of our participants stated they do not read current resuscitation guidelines. This indicates a need for awareness to follow these guidelines for continuing professional development among pre-hospital healthcare personnel.

When we asked, "Have you ever performed prone CPR?" 88.9% of the participants answered "no". This result may be due to the lack of training on prone CPR among pre-hospital healthcare personnel. Healthcare personnel might be reluctant to perform reverse CPR as a first option, especially due to the lack of specific training and knowledge of the procedure (7). Healthcare personnel involved in the care of prone positioned patients would also benefit from specific protocols for periodic training on how to perform CPR on a prone patient (7). In a study by Tejas Sinha et al., the importance of training and practice in prone CPR was emphasized. In their study, internal medicine residents were given prone CPR training using a simulation method with a cardiopulmonary arrest patient in the prone position, and participants indicated that this simulation training was beneficial for performing prone CPR in the future (18). In Genç et al.'s study, most physicians reported not having any training on prone CPR (19). This result is consistent with our finding that EMT's and paramedics in our study had not received post-graduation training on prone CPR. Such training is needed in our country for prone CPR.

Additionally, in a study by Tofil et al. on anesthesiologists, ventricular fibrillation (VF) was simulated during a spinal cord operation while the patient was operated on in the prone position. The participants' skills in recognizing and intervening in VF in prone patients were assessed.

Participants were divided into groups for the simulation study, and none of the groups performed prone CPR. Additionally, the average time to recognize VF in patients was 76 seconds, and the average time to start chest compressions was 77 seconds, indicating a delay in patient intervention (20). The authors concluded that anesthesiology residents need additional training in recognizing arrest and performing prone CPR in prone patients.

In our study, when comparing the total number of correct answers given by pre-hospital healthcare workers based on their years of experience, no statistically significant difference was found between the groups. This was thought to be due to the lack of in-service training after graduation. In a study by Kocalar et al., similar to our study, no significant relationship was found between the years of experience and knowledge levels of physicians (21). When comparing the years of experience of pre-hospital healthcare personnel participating in the survey with their prone CPR training status, no statistically significant difference was found between the groups in our study. In their study Güven et al. also concluded that there was no correlation between the years of experience and knowledge level (22). These findings indicate that professional experience alone is not sufficient to increase knowledge levels, and structured training is needed.

When examining the total number of correct answers based on the gender of our participants, the average number of correct answers given by males was 4, while the average number of correct answers given by females was 3. No statistically significant difference was found between the groups. Similarly, in a study by Aygin et al. on knowledge levels regarding CPR, no significant difference was found between genders (23).

It is important for pre-hospital healthcare personnel to have sufficient knowledge of prone CPR. Prone CPR can be applied by 112 emergency medical services during the transfer of patients monitored in the prone position or for patients found in arrest in the prone position at the scene to enable rapid intervention. Turning a patient transported in the prone position to the supine position for CPR inside the moving ambulance is technically challenging and time-consuming; therefore, performing prone CPR on patients transported in the prone position may be more appropriate. However, no studies on outcomes of prone CPR in ambulance were found in the literature, this may be an area of future research.

Limitations

The most significant limitation of our study is that it is single-centered. This prevents the generalization of our results. There is a need for multi-centered studies on prone CPR. Due to measurement convenience, only theoretical questions were asked in the study, and comparisons were made based on these. Adequate theoretical knowledge does not always directly show real-life applications. The sample of healthcare personnel participating in our study was not randomly selected; the survey form was offered to all pre-hospital healthcare personnel, but only those who voluntarily filled out the form participated in the study, which may have introduced bias in the sample.

Conclusion

intervention in managing cardiac arrest in patients monitored in the prone position in the hospital or ambulance or those experience cardiopulmonary arrest in the prone position in the field.

In our study, the percentage of correct answers to the knowledge questions about prone CPR was found to be low. Although during the COVID-19 pandemic, most ambulances carried patients in prone position at least once, the number of pre-hospital healthcare personnel performing prone CPR and their knowledge level on this subject were found to be low. Most pre-hospital personnel have not received any training on prone CPR. There is a need for training on performing prone CPR.

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