

Knowledge and Practice of Prone Cardiopulmonary Resuscitation Among Physicians: A Survey Study

Doktorların Prone Kardiyopulmoner Resüsitasyon Bilgi ve Uygulamaları: Bir Anket Çalışması

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ABSTRACT

Aim: Prone CPR has gained popularity recently during the COVID-19 pandemic. Prone CPR can be used to manage cardiopulmonary arrest in patients who are being treated in a prone position with an advanced airway in place or in patients who are being operated on in the prone position. It is important that physicians who work in the emergency department and intensive care units, where patients are treated in a prone position, have knowledge about prone CPR. In this study, our goal was to determine emergency department and intensive care physicians' level of knowledge about prone CPR as well as whether they have received training on prone CPR and whether they have applied prone CPR in their practice.

Material and Methods: This study surveyed physicians working in a hospital in the city center with approximately 650,000 emergency department presentations annually and 700 intensive care beds; the survey was conducted between December 2020 and March 2021. The participants were asked a total of 24 question, 18 of which elicited demographic information and educational status and six of which measured theoretical knowledge about prone CPR. The analysis of the data was performed using IBM SPSS 16.0 for Windows, and the significance value was accepted as $p < 0.05$.

Results: A total of 112 physicians participated in the study, 85 of whom were residents and 27 of whom were specialists. While 101 of the participants were working in the emergency room, 11 were working in the intensive care unit. The data indicated that, although the majority of the participants followed prone patients, they had not received training on prone CPR (86.6%) and did not perform prone CPR (92%).

Conclusion: Despite the increase in the number of patients followed in prone position and the use of prone CPR during the COVID-19 pandemic, physicians' lack of knowledge and experience with prone CPR continues; therefore, prone CPR needs to be included in CPR education.

Keywords: Cardiopulmonary resuscitation, prone position, emergency medicine

ÖZ

Amaç: Prone KPR özellikle son dönemde COVID-19 pandemisiyle birlikte tekrar gündeme gelmiştir. Prone pozisyonda takip edilen ileri havayolu olan hastalarda ya da prone pozisyonda opere edilen hastalarda gelişen arrestin yönetilmesinde Prone KPR kullanılabilir.

Hastaların prone takip edildiği acil servis ve yoğun bakımlarda çalışan hekimlerin bu konuda bilgi sahibi olması önem arz etmektedir. Bu çalışmada acil servis ve yoğun bakım hekimlerinin prone KPR konusunda eğitim alıp almadığı, bilgi düzeyi ve prone KPR uygulayıp uygulamadığının belirlenmesi amaçlanmıştır.

Gereç ve Yöntemler: Çalışmamız Aralık 2020-Mart 2021 tarihleri arasında şehir merkezinde yıllık yaklaşık 650000 acil başvurusu ve 700 yoğun bakım yatağı olan bir hastanede çalışan hekimlerin katıldığı bir anket çalışmasıdır. Katılımcılara 18'ü demografik bilgiler ve eğitim durumlarını sorgulayan, 6'sı teorik bilgi ölçeği toplamda 24 soruluk anket yöneltilmiştir. Verilerin analizi IBM SPSS 16.0 for Windows programında gerçekleştirilmiş ve anlamlılık değeri $p < 0,05$ olarak kabul edilmiştir. Çalışmamız Ankara Yıldırım Beyazıt Üniversitesi Tıp Fakültesi Klinik Araştırmalar Etik Kurulu'nun 16.12.2020 tarih ve 118 sayılı kararı ile etik ve bilimsel açıdan uygun bulunmuştur.

Bulgular: Çalışmaya 85'i asistan hekim, 27'si uzman hekim olmak üzere toplam 112 hekim katıldı. Katılımcıların 101'i acil serviste çalışırken 11'i yoğun bakımda çalışmaktaydı. Verilen yanıtlar incelendiğinde katılımcıların çoğunluğunun prone hasta takip etmiş olmasına rağmen daha önce prone KPR ile ilgili eğitim almadığı (%86,6) ve prone KPR yapmadığı (%92) gözlemlendi.

Sonuç: COVID-19 sırasında prone hasta takibi ve prone KPR artmış olmasına rağmen hekimlerin prone KPR konusunda bilgi ve deneyim eksikliği devam etmekte olup, bu konuya KPR eğitimlerinde yer verilmesine ihtiyaç vardır.

Anahtar Kelimeler: Kardiyopulmoner resüsitasyon, prone pozisyon, acil tıp

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Introduction

Prone cardiopulmonary resuscitation (CPR) or reverse-CPR can be defined as CPR performed in the prone position. The concept of prone CPR was first introduced in 1989 (1).

In the emergency room and in intensive care units, patients can be positioned in the prone position to improve oxygenation. Prone position is especially useful in patients with acute respiratory distress syndrome (ARDS) who are on mechanical ventilation, and it is also used during some operations (2). The positive effects of a prone position on hypoxia have been demonstrated in non-intubated patients with lung involvement (3). During the COVID-19 pandemic, a prone position has been used in many patients to improve oxygenation (3). Therefore, the number of patients being treated in a prone position who experience cardiopulmonary arrest may have increased (4).

When a patient in the prone position experiences cardiopulmonary arrest, CPR can be performed in either a supine or prone position (2,4). Although the information on prone CPR is limited, studies have shown that prone CPR has comparable results with supine CPR (2). While performing prone CPR, the hands should be placed on the T7-T9 vertebrae, and the patient should be on a hard surface. As with routine CPR, the compression rate should be 100–120 compressions per minute, and complete recoil should be allowed. Defibrillation pads can be placed on both armpits as well as on the left mid-axillary line and the right scapula (2,5).

Prone CPR may be beneficial for especially the patients who are followed in the prone position. But there are very few studies about the knowledge and willingness of physicians about prone CPR. The aim of this study is to determine via a questionnaire the education, knowledge, and daily practice related to prone CPR of doctors working in the emergency department and the intensive care unit of a city hospital with 700 intensive care beds and approximately 650,000 emergency service visits per year.

Material and Methods

This study was conducted at Ankara City Hospital between December 2020 and March 2021. A questionnaire was administered to residents, attending physicians, and faculty members working in the emergency department and the intensive care unit.

Ethics approval of the study was granted by Yildirim Beyazıt University Faculty of Medicine Clinical Research Ethics Committee in December 2020 (16.12.2020/18).

The participants completed a questionnaire consisting of 24 questions. The first 18 questions related to demographic characteristics and educational/training status. Questions are as followed. 1. Informed consent 2. Age 3. Gender 4. How long have you been practicing medicine? 5. What is your title? 6. Which department are you working in? 7. Did you work in COVID ward or COVID Intensive Care Unit (ICU)? 8. How long have you been working in Emergency Department or ICU? 9. Did you receive any training about Prone CPR? 10. If you received training how many hours was it? 11. If you receive training which year did you receive it? 12. If you receive training was it in medical school, during or after residency? 13. Did you read any guideline about Prone CPR?

14. Did you received any certificated education about supine CPR? 15. Before COVID-19 pandemic did you perform prone CPR? 16. If yes in the 6 months before the pandemic how many times approximately did you perform prone CPR? 17. During the COVID pandemic did you perform prone CPR? 18. If yes, in the last 6 months how many times approximately did you perform prone CPR? The last six questions were multiple choice questions about prone CPR (Table 3). The survey form was created via Google Surveys and sent to the participants via e-mail. A reminder was sent to each participant via e-mail three times at two-week intervals. Inclusion criteria for the study were as follows: 1) being an emergency medicine resident, attending physician, or faculty member or an intensive care resident, attending physician, or faculty member, and 2) working at Ankara City Hospital.

The exclusion criteria were not responding to all of the survey questions, incomprehensible markings on the questionnaire, and having more than one sign in the same answer field.

IBM SPSS Statistics Version 16 was used to evaluate the survey result data. Frequency distributions are given for categorical variables, and descriptive statistics are given for continuous variables. The Shapiro–Wilk normality test was applied for continuous variables in the study. The non-parametric Mann–Whitney U test was used for the median comparisons of two independent groups whose normality assumption was not provided ($p < 0.05$) as a result of the test. The Independent Samples t test was used for the comparison of the two group means in normally distributed data. The chi-square test was applied for ratio comparisons of independent frequency data (on 2×2 , 3×2 tables, etc.). The Pearson correlation test was used for normally distributed data, and Spearman's correlation coefficient was used for non-normally distributed data. A value of $p < 0.05$ was considered statistically significant.

Results

The questionnaire was delivered to 207 physicians working in the emergency room and intensive care unit. A total of 112 physicians participated in the study. Demographic characteristics of the participants are summarized in Table 1. Of the participants, 79.5% ($n = 89$) had worked in the COVID service/intensive care unit for at least one month in the previous six months, and 20.5% ($n = 23$) had not worked in the COVID service/intensive care unit in the previous six months.

Table 2 shows whether the participants had previously received training on prone CPR, and if so, when this training took place. Table 2 also shows approximate prone CPR performance numbers before and after the pandemic.

The answers of the participants to the knowledge questions asked about prone CPR are given in Table 3.

The median value of the total correct number of answers given by the participants working in the emergency department was 4 (IQR 3–5), and the median value of the total correct number of answers by the participants working in the intensive care unit was 3 (IQR 3–4). There was no difference between the two groups ($p = 0.152$).

| | | N(%) |
|--|----------------------|--------------|
| Gender | Male | 71(63,4) |
| | Female | 41(36,6) |
| Total years of working as a doctor | 0-5 | 57(50,9) |
| | 6-10 | 32(28,6) |
| | >10 | 23(20,5) |
| Title | Resident | 85(75,9) |
| | Attending physician | 18(16,1) |
| | Faculty member | 9(8) |
| Current department of work | Emergency department | 101(90,2) |
| | ICU | 11(9,8) |
| | | Mean± |
| Age | | 31±5 |
| Total years of working in emergency department or ICU | | 5±5 |

Table 1. Demographic characteristics of the participants

We compared the median value of the total number of correct answers between the job titles of the participants: the median value of the total correct number of answers provided by residents was 4 (IQR 3–5), and the median value of the total correct number of answers provided by attending physicians and faculty members was also 4 (IQR 3–5); there was no difference between the groups. (p = 0.843). When the questions were examined individually, only on the 4th question (“Can prone CPR be applied to children?) was there a significant difference between the ratio of correct answers given by the residents and attending physicians. While 85.9% (n = 73) of the resident physicians answered this question correctly, only 66.7% (n = 18) of the attending physicians gave the correct answer. The difference was statistically significant (p = 0.026).

The median value of the total number of correct answers in physicians with 0–5 years’ experience was 4 (IQR 3–5), in physicians with 6–10 years’ experience was 4 (IQR 4–5), and >10 years of experience was 4 (IQR 3–5). There was no difference between the groups (p = 0.216).

There was no difference between the groups who had received previous training in prone CPR and those who had not received previous training in prone CPR in terms of the number of correct answers provided to the six questions about prone CPR (p > 0.05). While 86.1% (n = 87) of the physicians working in the emergency department did not have any previous training in prone CPR, this figure was 90.9% (n = 10) for physicians in the intensive care unit. There was no difference between the groups (p = 1.000).

| Questions | Answers | N (%) |
|--|-----------------|------------|
| Have you received training on prone CPR before? | No | 97 (86.6) |
| | Yes | 15 (13.4) |
| Have you read any guidelines on prone CPR? | No | 75 (67) |
| | Yes | 37 (33) |
| Have you participated in any certified training program on routine CPR? | No | 57 (50.9) |
| | Yes | 55 (49.1) |
| Had you ever performed prone CPR before the COVID-19 pandemic? | No | 110 (98.2) |
| | Yes | 2 (1.8) |
| Have you performed prone CPR since the COVID-19 pandemic began? | No | 103 (92) |
| | Yes | 9 (8.0) |
| Do you perform CPR in the prone position or in the supine position when an intubated patient lying in the prone position is having a cardiopulmonary arrest? | Prone position | 16 (14.3) |
| | Supine position | 96 (85.7) |

Table 2. Doctors’ previous training and performance of prone CPR

| | | N (%) |
|--|---|------------|
| Q19. During advanced life support, can prone CPR be performed on a patient without advanced airway (endotracheal intubation or supraglottic airway)? | No* | 62 (55.4) |
| | Yes | 50 (44.6) |
| Q20. On which vertebrae should the hands be placed in prone CPR? | T1-T4 | 15 (13.4) |
| | T4-T7 | 65 (58.0) |
| | T7-T10* | 32 (28.6) |
| Q21. How many chest compressions per minute should be administered in prone CPR? | 80–100 | 14 (12.5) |
| | 100–120* | 96 (85.7) |
| | 120–140 | 2 (1.8) |
| | No | 21 (18.8) |
| Q22. Can prone CPR be performed on children? | Yes* | 91 (81.2) |
| | Biaxiller | 8 (7.1) |
| | Front-Back | 23 (20.5) |
| | No | 28 (25.0) |
| Q23. Where should the defibrillator pads be placed in prone CPR? | Between vertebral column and right scapula-axilla | 28 (25.0) |
| | All* | 53 (47.3) |
| Q24. Can the quality of prone CPR quality be monitored with End tidal CO2 level? | No | 12 (10.7) |
| | Yes* | 100 (89.3) |

*correct answer

Table 3. Questions measuring physicians' level of knowledge about prone CPR

Discussion

Approximately 10% of intensive care hospitalizations are for acute respiratory distress syndrome, and ventilation in the prone position has been shown to be beneficial for refractory hypoxemia and to reduce mortality in these patients (6,2). During the COVID-19 pandemic, many patients were admitted to the intensive care unit due to persistent refractory hypoxemia, and the prone position was frequently used in these patients since mechanical ventilation in the prone position can improve oxygenation (2).

There is no consensus on whether to perform CPR in the prone or supine position when a patient treated in the prone position develops cardiopulmonary arrest; neither is there any detailed information on how to perform prone CPR in most of the guidelines (2). The American Heart Association recommends that when a patient who is being treated in the prone position due to COVID-19 experiences cardiopulmonary arrest, if the patient does not have an advanced airway, the patient should be turned to the supine position for the administration of CPR, but if the patient has an advanced airway, prone CPR can be performed (5). Most of the studies on prone CPR are case reports, case series, or non-randomized mannequin or cadaver studies (4). Our

study is the first study to measure the knowledge and education status of physicians on this subject and their experience in daily practice.

There are well-defined standard guidelines for basic life support and advanced cardiac life support in the supine position (2). To turn a patient treated in the prone position to the supine position for CPR, a team of three to six people is required (2,4). In the process of quickly turning a patient who is in the prone position to the supine position for CPR, the patient's vascular access, connected monitor equipment, and intubation tube may become dislodged, which may create a risk to the patient and healthcare personnel. Turning a patient to the supine position may take up to three minutes (2), and it may have a negative effect on patient outcome by delaying chest compressions and defibrillation (7, 8). For the reasons listed above, prone CPR is a logical alternative for patients with an advanced airway if cardiopulmonary arrest occurs while they are being treated in the prone position (2, 5). In 2001, Brown et al. published a review of 22 cases in which CPR was performed in the prone position (9). In 2003, Mazer et al. showed that higher systolic blood pressure and mean arterial pressure were obtained during prone CPR compared to standard CPR in patients whose spontaneous circulation did not return

after 30 minutes of supine CPR (10). Prone CPR may also be a good alternative out of hospital for rescuers to avoid mouth-to-mouth breathing. To reduce the risk of transmission, which has gained importance during the COVID-19 pandemic, hands-only CPR can be considered an alternative in the prone position. The patient's tongue does not obstruct the airway due to gravity in prone CPR. A study conducted in 2006 showed that a tidal volume of approximately 6 ml/kg was obtained with only prone chest compressions and no rescue breaths. Since there is also air inflow and outflow, hands-only prone CPR can be considered an alternative out of hospital (11).

The majority of the physicians participating in our study had not received any training on prone CPR, had not read any guidelines on this subject, and stated that they performed CPR in the supine position even if the patient was being treated in the prone position when cardiopulmonary arrest occurred. The reason for this was thought to be the physicians' lack of knowledge and experience with prone CPR. A study conducted by Tofil et al. found that anesthesia assistants needed additional training on the recognition of arrest in prone patients and on prone CPR (12). Sinha et al. drew attention to the importance of training and practicing prone CPR in their study, in which prone CPR training was given to internal medicine residents by simulating a patient with prone arrest; the participants stated that the simulation training was beneficial in preparing them to perform prone CPR in the future (13). The familiarity of physicians with this issue may increase the frequency of performance of prone CPR (2). Our results also support the need for theoretical and practical training on prone CPR.

Of the participants in our study, 50.9% stated that they had not participated in any certified training program on routine CPR. American Heart Association recommends renewal of ACLS training certificate every two years to ensure best practice skills for health care personnel (14). This result showed that there is a lack of postgraduate training not only in prone CPR but also in routine CPR. The findings of a survey study investigating physicians' level of knowledge about supine CPR were similar to our findings. The authors concluded that doctors did not have sufficient knowledge about routine CPR. Years of experience as a physician or education on the subject did not affect the level of knowledge (15). In our study, the total number of questions answered correctly did not differ between residents, attending physicians, and faculty members, and there was no correlation between the years of professional experience and the number of questions answered correctly.

In our study, the rate of correct answers to questions that measured knowledge that did not differ between routine CPR and prone CPR (question 19, 21, 22 and 24) was higher than other questions. The lowest number of correct answers was given to questions related to the position of the hands (28.6%) in prone CPR and the placement of defibrillator pads (47.3%); these questions could not be answered correctly based on knowledge acquired from routine CPR training. American Heart Association only give certificate that score over 84% from the written exam (14). In our study the median value of the total correct number of answers given by the participants working in the emergency department was 4/6 (66 over 100) (IQR 3–5), and the median value of the

total correct number of answers by the participants working in the intensive care unit was 3/6 (50 over 100) (IQR 3–4). Thus, we think there is a need to include theoretical and practical issues related to prone CPR in routine CPR training.

Limitations

The most important limitation of our study was that it was conducted in a single center. This prevents the generalizability of our results. Also, the participation of intensive care physicians in our study was lower than expected due to the increased workload caused by the pandemic.

In addition, only the level of theoretical knowledge could be measured in the study. Measuring physicians' practical application of prone CPR would give a better idea of their practical skills.

We didn't ask the percentage of patients who were followed in prone position. Thus, we do not know the real need of prone CPR in our facility.

Finally, we predicted that the number of physicians who performed prone CPR would be higher due to the pandemic. However, the study showed that this rate was lower than expected. This reduced the power of some statistical data.

Conclusion

Prone CPR is a recommended method especially for patients being treated in the prone position in the intensive care or emergency department with advanced airway or for patients being operated on in the prone position. We found that most of the emergency physicians and intensive care physicians participating in our study had received no previous training in prone CPR either before or after graduating from medical school. We found the percentage of correct answers to questions about prone CPR was low. The rate of physicians performing prone CPR increased during the COVID-19 pandemic in our facility and it was thought that the lack of knowledge and experience of physicians in prone CPR played a role in this. These findings indicate that physicians need training on this subject to increase their knowledge and practical skill levels in performing prone CPR.

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Ethical Approval: Ethics approval of the study was granted by Yildirim Beyazit University Faculty of Medicine Clinical Research Ethics Committee in December 2020(16.12.2020/18).

The participants were informed about the study through an explanation paragraph before the start of Google survey, and their consent was obtained before they start to answer questions.

The study protocol conforms to the ethical guidelines of the 1975 Declaration of Helsinki as reflected a priori approval by the institution's human research committee.

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