

Investigation of emergency medicine residents' skills in using external pacemakers

Samiye Kocal,¹ Fevzi Yılmaz,² Mehmet Berk Eyiç,² Hüseyin Öztoprak,² İlker Şirin³

¹Emergency Department, Bingöl State Hospital; ²Emergency Department, University of Health Sciences, Antalya Training and Research Hospital; ³Emergency Department, Ankara Etlik City Hospital, Turkey

Abstract

External pacing is one of the most efficient methods of treating multiple conduction abnormalities. The goal of this study was to determine how well Emergency Medicine Residents (EMRs) could use external pacemakers and how much they learned after training. The study investigated resident physicians who were pursuing

Correspondence: İlker Şirin, MD, Ankara Etlik City Hospital, Department of Emergency Medicine, Varlık, Halil Sezai Erkut Street 5, 06170 Yenimahalle, 06110 Ankara, Turkey.
Tel.: +905414684309.
E-mail: sirinilkerr@gmail.com

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Ethics approval and consent to participate: our study was conducted after the approval of Antalya Training and Research Hospital Clinical Research Ethics Committee (07/09/2023 date and 2023-184 decision no:12/2). The study conforms with the Helsinki Declaration of 1964, as revised in 2013, concerning human and animal rights.

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their education at a department of Emergency Medicine (ED) in a tertiary hospital. The physicians who agreed to participate in this study were initially tested on the application of external pacemakers. They were then provided with both theoretical and practical instructions on the external pacemaker before undergoing a post-test assessment. The prior external pacemaker application skills and the pre-test and post-test results of the resident physicians were compared. It was found that 22.5% of the participants (n=9) had been working in the ED for 0-1 year, whereas 37.5% (n=15) had been working in the ED for 3-4 years. Furthermore, 36 (90%) participants had previously witnessed an external pacemaker application, and 29 (72.5%) had used an external pacemaker before. A mean score of 10.28 ± 2.5 was obtained from the participants in the pre-test phase, while the post-test score was recorded as being 13.03 ± 1.67 . Statistical analysis indicated significant increases in scores after training ($p < 0.001$), leading to the conclusion that theoretical and practical training can enhance the external pacemaker competencies of emergency department residents.

Introduction

Research has shown that the training received by emergency medicine residents in many diagnostic and therapeutic applications does educate and improve skills.¹ However, there have been no recommendations in the literature on the nature of external pacemaker training in international guidelines or resuscitation studies.²

The increasing elderly population is leading to a rise in the incidence of cardiovascular diseases. This means that the use of cardiac pacemakers in the Emergency Department (ED) will undoubtedly increase.³ Thanks to the transcutaneous pacemaker, hemodynamic parameters that are impaired due to fast or slow heart rates are temporarily corrected, and circulatory integrity is preserved.^{4,5} Transcutaneous pacemakers are now available for immediate use in many critical patient care units, especially in emergency rooms and coronary intensive care units.

The EM residency program in Turkey complies with standards set by the EM Specialization Training Core Curriculum of the Medical Specialization Board Curriculum Creation and Standard Determination System (TUKMOS). One of TUKMOS's training objectives is the transcutaneous pacemaker application. According to the curriculum, an emergency physician should be able to perform this procedure in an emergency with a guide or instructions.⁶ Although training on the indications and use of external pacing is a standard part of the EM curriculum, no data has been identified to demonstrate its effectiveness. A further review of the literature reveals that there is a limited number of studies that address the use of external pacemakers.

The present study has two main aims: first, to gauge the knowledge of external pacemakers among emergency medicine residents at the ED Clinic of Antalya Training and Research Hospital, and

second, to compare pre-test and post-test scores following both theoretical and practical training.

Materials and Methods

Prior to the study, written informed consent forms were obtained from all participants, and approval was granted from the Health Sciences University Antalya Education and Research Clinical Research Ethics Committee (07/09/2023; 2023-184 decision no. 12/2). The study was conducted on 40 EM resident physicians who were continuing their education at the Health Sciences University Antalya Training and Research Hospital ED. A pre-test was administered to the physicians who agreed to participate in a study on external pacemaker applications. All of the physicians involved in the study were subsequently given theoretical and practical training on external pacemaker applications, followed by a post-test. Demographic information relating to the resident physicians, their previous external pacemaker application history, and their pre-test and post-test scores were compared and analyzed.

External pacemaker training application

Participants in the research received one hour of theoretical and practical training on external pacemaker applications, which included indications, contraindications, application techniques, complications, and their management. Current studies in the literature were reviewed in the creation of training on the external pacemaker.⁶ The training materials and content created from the collected data were presented to the participants on a slide. Following a check by a medical instructor, practical applications were performed using an external pacemaker device from Nihon Kohden (Japan; TEC-7531K model). The subjects took a pre-test before training to measure how much they knew about external pacemaker applications (*Supplementary Table 1*). The training was followed by a post-test with identical questions in order to gauge how much they had learned from the training accurately. The knowledge of the respondents was evaluated with a 16-question multiple-choice test. Each correct response was awarded one point, while incorrect answers received no points, thus providing each informant with a score between 0 and 16. Resident physicians who

participated in the external pacemaker application training were categorized according to the length of their residency, and the groups were compared.

Statistical analysis

The software used to analyze the collected data was the Statistical Package for the Social Sciences (SPSS) for Windows Version 27 (IBM Corp., Armonk, NY, USA). As the sample size was less than 50, the Shapiro-Wilk test was used to determine whether the continuous data followed a normal distribution. For continuous data following a normal distribution, a paired sample t-test was used to evaluate the outcomes for independent samples, while for the data that did not meet the normality assumption, the Mann-Whitney U test was used. Furthermore, the McNemar test assessed changes in correct response rates between the pre-test and post-test. Nominal categorical data was presented as percentages, with $p < 0.05$ being considered statistically significant.

Results

In the study, 13 (32.5%) of the participating physicians were female, while 27 (67.5%) were male, and the mean age was 29.5 ± 3.22 years. Additionally, 22.5% ($n=9$) had 0-1 years of work

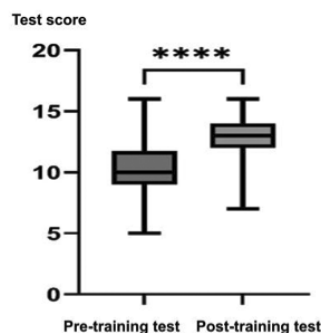


Figure 1. Change in score between pre-test and post-test.

Table 1. Demographic data of EM residents, years of training, and number of external pacemaker applications.

	n	%
Gender		
Female	13	32.5
Male	27	67.5
Work experience		
First year	9	22.5
Second year	5	12.5
Third year	11	27.5
Fourth year	15	37.5
Mean±SD		3.9±1.67
Those who have not applied an external pacemaker before	11	27.5
Those who have applied an external pacemaker before	29	72.5
Number of external pacemaker applications		
1-3 times	20	50
3-5 times	4	10
6-10 times	4	10
More than 10 times	1	2.5

experience, and 37.5% (n=15) had 3-4 years of work experience. In terms of knowledge of external pacemakers, 27.5% of the respondents stated that they had never used one, 90% said that they had witnessed the application of one, and 72.5% stated that they had previously used an external pacemaker. Further details of the external pacemaker application and the demographic information of the participants are provided in Table 1.

Participants were given a pre- and post-training test consisting of 16 questions. Table 2 shows the distribution of correct answers to the questions before and after training. The comparison showed a significant increase in the number of correct answers to questions 1, 2, 7, 13, and 16 after training. In question 12, although there was a decrease in the number of correct answers, this decrease was not statistically significant.

The participants' mean score after their pre-test answers was 10.28 ± 2.5 , compared to 13.03 ± 1.67 after their post-test answers. The statistical comparison determined that the scores increased significantly after training ($p < 0.001$) (Figure 1). It was determined that the gender of the participants, their previous experience with the application, and their earlier application did not markedly affect the changes in the scores obtained in the tests conducted before and after the training (Table 3). When the change in the pre-test and post-test scores of the participants was compared accord-

ing to their years of working in the ED, no significant disparity was found in the tests according to years of experience (Figure 2).

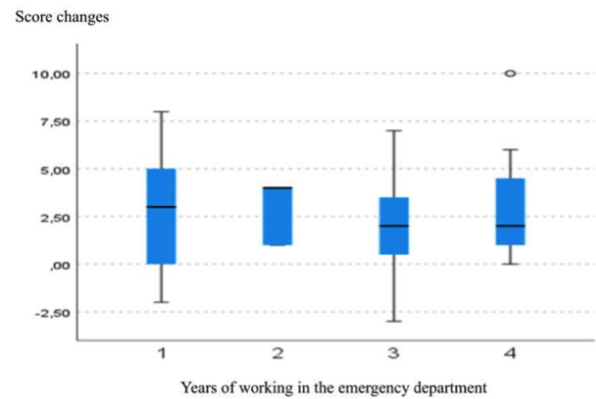


Figure 2. Comparison of the score changes according to the years of working in the ED.

Table 2. Comparison of correct answers in the pre- and post-test.

Question number	Pre-test		Post-test		p
	n	%	n	%	
1	21	52.5	38	95	<0.001
2	18	45	30	75	0.004
3	39	97.5	40	100	1.000
4	29	72.5	31	77.5	0.754
5	34	85	39	97.5	0.063
6	36	90	37	92.5	1.000
7	24	60	39	97.5	<0.001
8	24	60	32	80	0.115
9	13	32.5	13	32.5	1.000
10	28	70	35	87.5	0.065
11	27	67.5	34	85	0.065
12	34	85	32	80	0.687
13	28	70	37	92.5	0.012
14	16	40	19	47.5	0.508
15	31	77.5	35	87.5	0.219
16	9	22.5	30	75	<0.001

Table 3. Factors affecting the scores obtained from the tests conducted before and after the training.

Change in the scores	n	Median	IQR	p
Gender				
Female	13	3	3	0.977
Male	27	2	4	
Have you ever witnessed an external pacemaker application?				
No	4	4,5	3.25	0.074
Yes	36	2	3.75	
Have you ever applied an external pacemaker?				
No	11	3	5	0.743
Yes	29	2	3	

Discussion

The results of this study demonstrate that appropriate training increased the knowledge of emergency medicine residents on the use of external pacemakers. This can be seen from the increase in the number of correct answers from 14 of 16 on the test asked to emergency medicine residents. The results show that even short-term training can significantly increase knowledge of the application of external pacemakers. Although no long-term evaluation has been performed, it can be concluded that the optimal method for increasing and maintaining knowledge of external pacemakers can be enhanced through repeated training.⁷

When the data was examined in detail, it was determined that the physicians who had not previously seen or applied a transcutaneous pacemaker application were in the first year of their residency training. Bilge *et al.* found that the rate of transcutaneous pacemaker application increased in proportion to the number of years the residents had been trained.⁸ This finding is consistent with the results of our study. While the number of patients with indications for transcutaneous pacemaker application in the ED was relatively low, this number of applications increased according to the time spent in residency.

In Ranger *et al.*'s study on the adequacy of transcutaneous cardiac pacing in young residents attending an Advanced Cardiac Life Support (ACLS) course, a significant difference was identified between the trained group and the control group in terms of transcutaneous pacemaker application.⁹ Kowalski *et al.*'s research on final-year medical school students was entitled "Effective methods for increasing cardioversion and transcutaneous cardiac pacing skills."¹⁰ In this work, students were given basic training, after which they were divided into three groups. The first two groups received additional training after nine weeks, with one of the groups also receiving practical training. The third group, on the other hand, received no training other than the first training session. In the 10-week evaluation, the group that received three training sessions was statistically determined to be significantly more effective in cardioversion and transcutaneous pacemaker application than the other groups. The study drew attention to the training of temporary transcutaneous pacemaker implantation and showed that well-planned training can increase the success of its use.

Conclusions

As the transcutaneous pacemaker is not widely used in the ED, ED physicians need to be more aware through repeated practical training. This will allow pacemaker indications to be accurately determined, thus reducing patient mortality through early intervention. This study drew attention to the training of temporary transcutaneous pacemaker implantation and showed that well-planned training can increase the rate of success. A unique feature of this study is that the training course can be planned and implemented quickly.

Transcutaneous pacemaker applications are underutilized due to limited indications for external pacing and a lack of experience and knowledge among resident physicians regarding the device and its use. Other factors that limit application are the high cost of

these devices and the fact that transcutaneous pacemaker pads are disposable. There is no doubt that transcutaneous pacemakers, which play an active role in reducing mortality, should be in more effective general use. This can be facilitated through frequent and effective training, which would lead to the correct application methods being used in ED clinics.

Limitations

The study has some limitations. As it was conducted at a single center, the findings cannot be generalized to all hospitals. Therefore, it is recommended that a more comprehensive investigation be carried out, involving physicians from multiple centers. Additionally, while the present study was conducted only with assistant physicians, transcutaneous pacemakers should be known and implemented by all of the practitioners, assistants, specialists, and faculty members who work in an ED, as there is no doubt that theoretical and practical training would be more efficient when all physicians working in the ED are included.

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Titolo

Autore

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Introduction

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