Evaluation of chest deformity, return of spontaneous circulation and 28-day survival rates after CPR with chest compression device in patients admitted to the emergency department due to cardiac arrest

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Cardiac arrest (CA) is a serious threat to human health. Cardiopulmonary resuscitation (CPR) is an effective treatment for CA. Early and high-quality CPR is closely associated with the survival rate of patients with CA. However, manual application of chest compressions has some handicaps. Over time, mechanical CPR devices have been invented to solve these problems and improve CPR quality.

In our case-series report, we use a chest compression device CEPER© it has produced in Turkey with domestic and national capital. It applies 5.2 mm chest compressions 110±2 times per minute. We use the device for treatment of the patients who were admitted to the etmergency department due to cardiac arrest between 01 March and 31 August 2022. In total, 48 of 55 patients were suitable for chest compression device use.

Table 1. figure 1 and 2: Using CEPER chest compression device on patients. 3: Using CEPER on Adult CPR model

We evaluated the patients according to their gender and age groups. We also grouped them according to the causes of arrest. Here, we considered the last situation that led to the development of cardiac arrest in the patient. In prehospital cases; we examined the duration of arrest and the duration of prehospital CPR after the first aid teams arrived. We also examined the prehospital airway management and intubation status of the patients. We measured the waiting times, intubation status, and the time to apply chest compressions and CPR from the moment they arrived at the hospital as a pre-hospital arrest. The data we obtained as a result of the evaluation made us think that the probability of return of spontaneous circulation may increase as the waiting time of patients in prehospital arrest decreases and the rate of successful tracheal intubation increases.

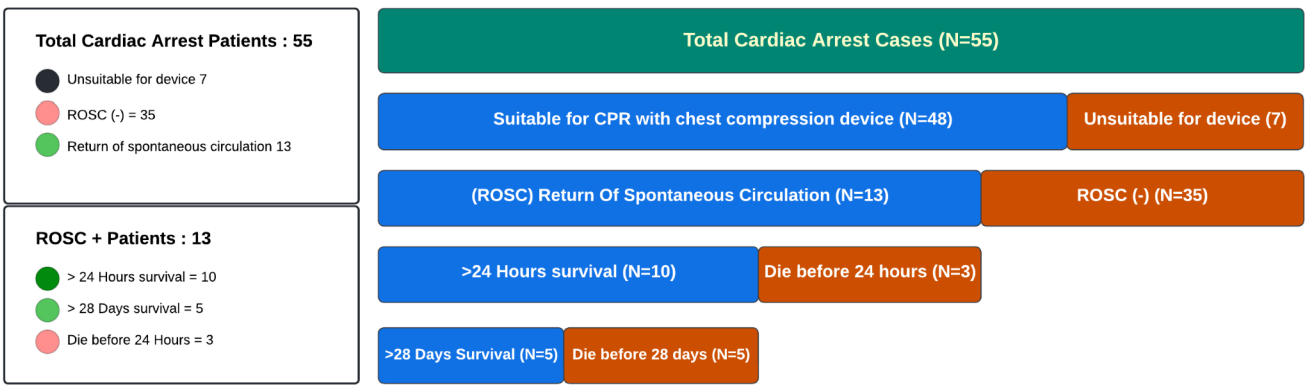

Figure 1:
General evaluation diagram of the study;
The total number of patients is 55. 48 of these patients were found suitable for chest compression device application. Survival rate of more than 28 days was observed in 5 patients out of a total of 13 patients with spontaneous return of circulation.

Details of the evaluation of our patients according to their demographic characteristics and possible causes of arrest are given in the table.

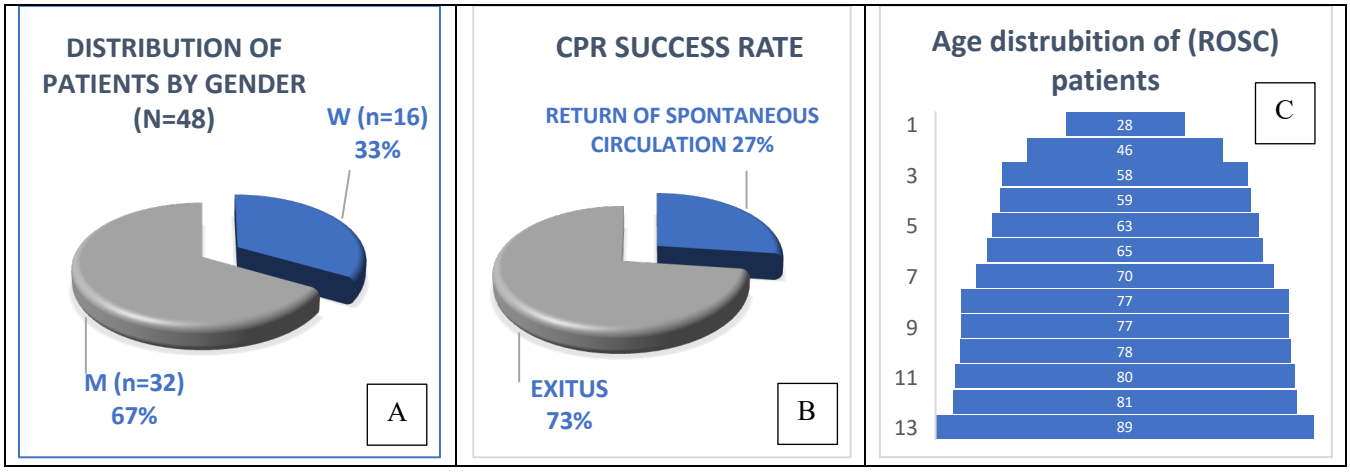

Table 2.
A)Distribition of patients by gender, **B)**CPR success rate of patients,
C)Age distribition of patients (ROSC group)

A) When the distribution of 48 patients who underwent CPR with CEPER chest compression device according to gender was examined; There were 32 male (M) and 16 female (F) patients.
B) Considering the return of spontaneous circulation as a success, the return of spontaneous circulation was achieved in 27% of patients who underwent CPR with the CEPER Chest compression device.
When the rates of patients who were returned were examined, it was seen that 4 were female and 9 were male.
C) When the age distribution of patients whose spontaneous circulation returned was examined, the mean age was 67 years, and it was noted that more than half of the patients were over 70 years of age.

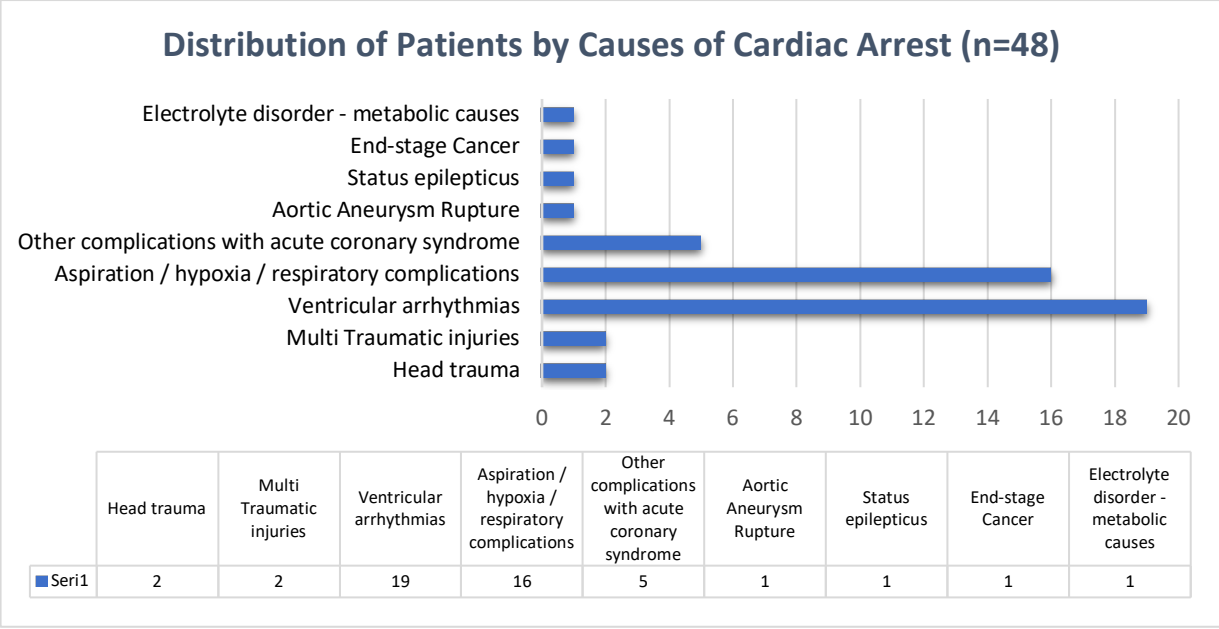

Figure 2. Distribution of patients by causes of cardiac arrest

When the patients were examined according to the causes of cardiac arrest; traumatic and cardiac causes are more common in patients younger than 60 years of age, pulmonary causes and respiratory complications increase significantly, especially in patients over 60 years of age and older.

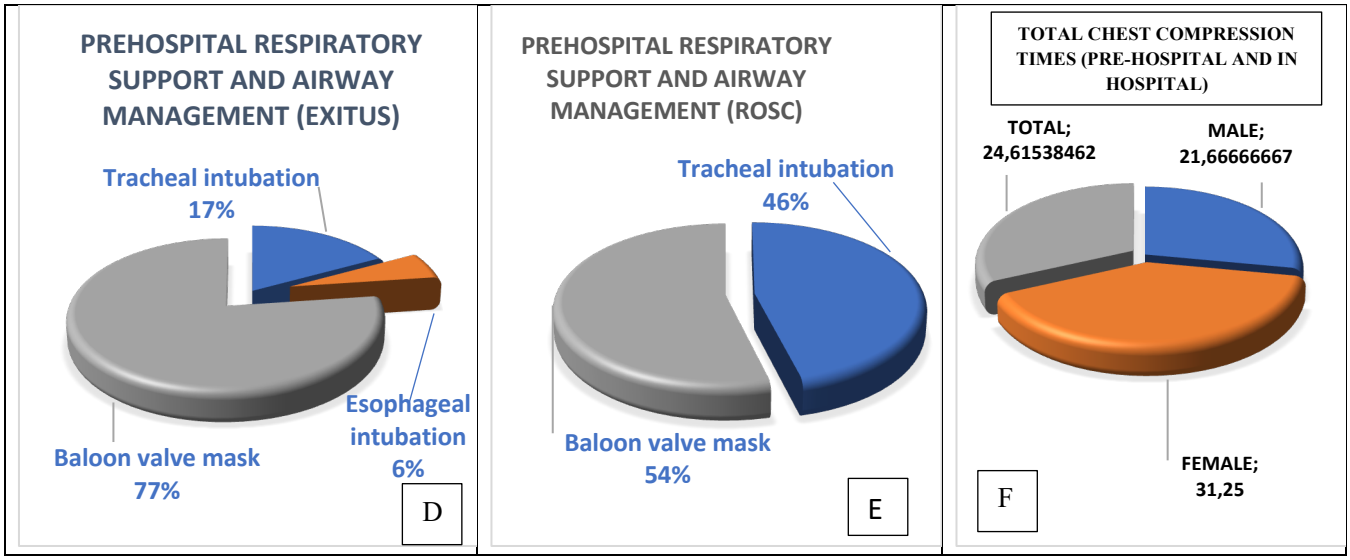

Table 3.

D)Prehospital respiratory support and wirway management in the Exhitus group **E)**Prehospital respiratory support and airway management of ROSC group **F)**Total chest compression times in ROSC group

D) Prehospital airway management and respiratory support status of patients with EXITUS
E) Prehospital airway management and respiratory support status of patients (ROSC)
F) Total chest compression application times in prehospital and hospital emergency departments in patients with spontaneous circulation returned (min)

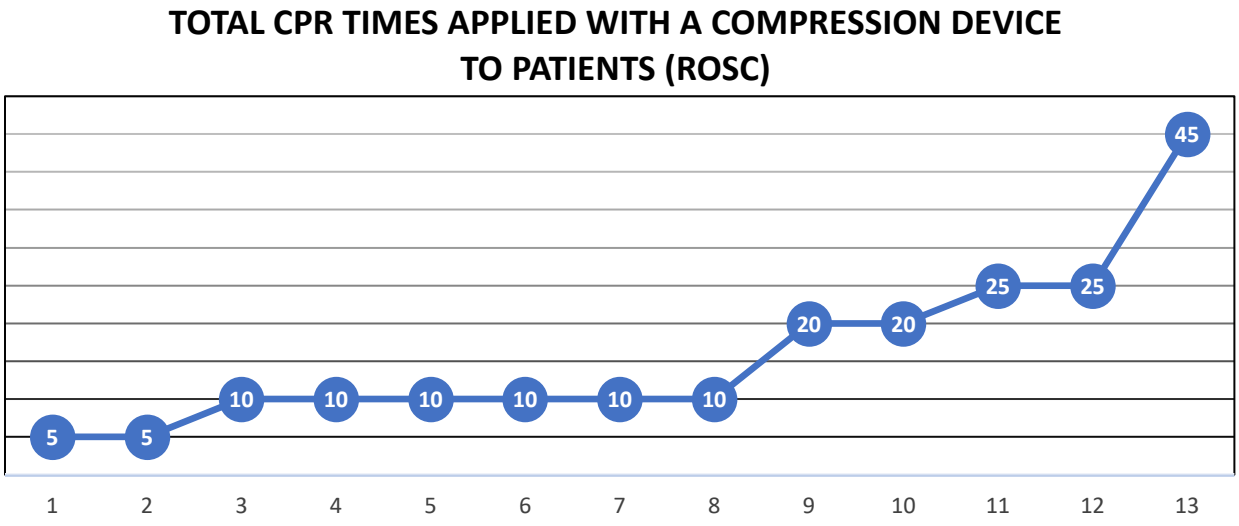

Figure 3.

Total CPR times applied with a compression device to patients wich returned spontaneous circulation

When the total CPR – Chest Compression – times applied with the compression device in the hospital to the patients whose spontaneous circulation returned (n=13) were examined, it was seen that the average time was 15 minutes and this time reached 45 minutes in 1 patient. When the durations applied to other patients were examined, it was observed that this duration was 10 minutes or less in 61% (n=8) of the patients.

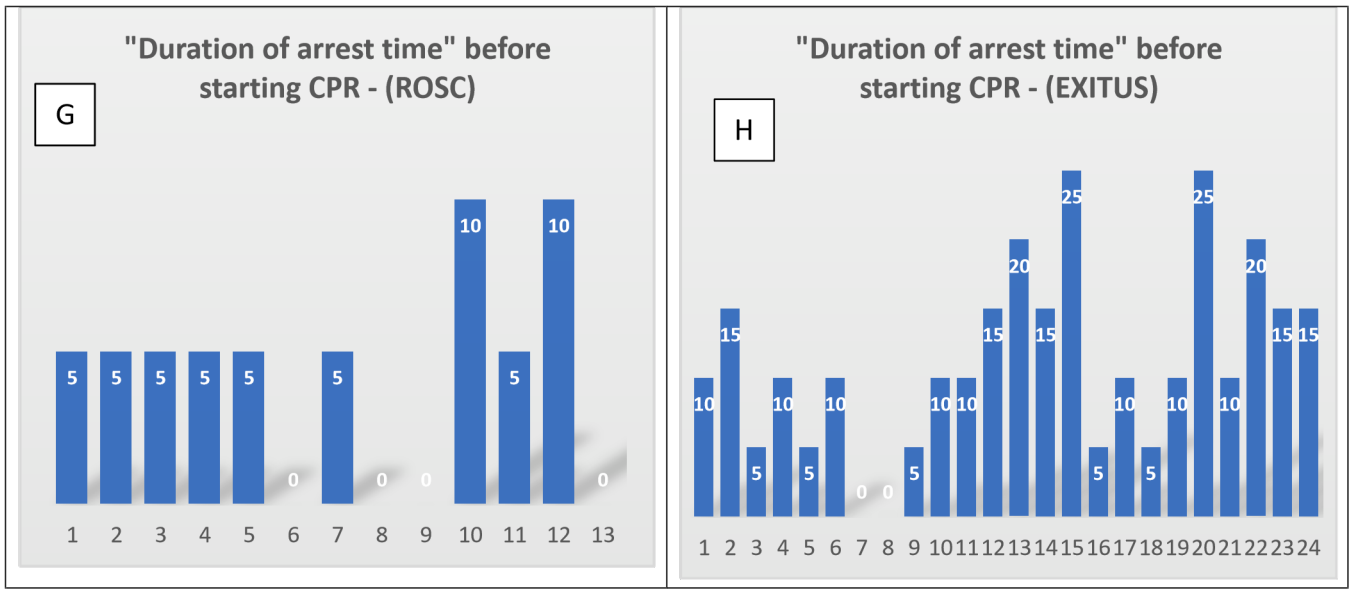

Table 4.

G)Pre-hospital Arrest duration of patients whose spontaneous circulation returns (Time before starting CPR) **H)** Pre-hospital Arrest duration of patients whose spontaneous circulation does not return (Time before starting CPR)

When the waiting times of the patients before applying chest compressions were examined, it was seen that this time was 4.5 minutes on average in the patient group where spontaneous circulation returned, while this time was 12.5 minutes on average in the patient group where the circulation did not return. In addition, in the patient group where spontaneous circulation returned, the waiting time in prehospital arrest was 10 minutes or less in all patients.

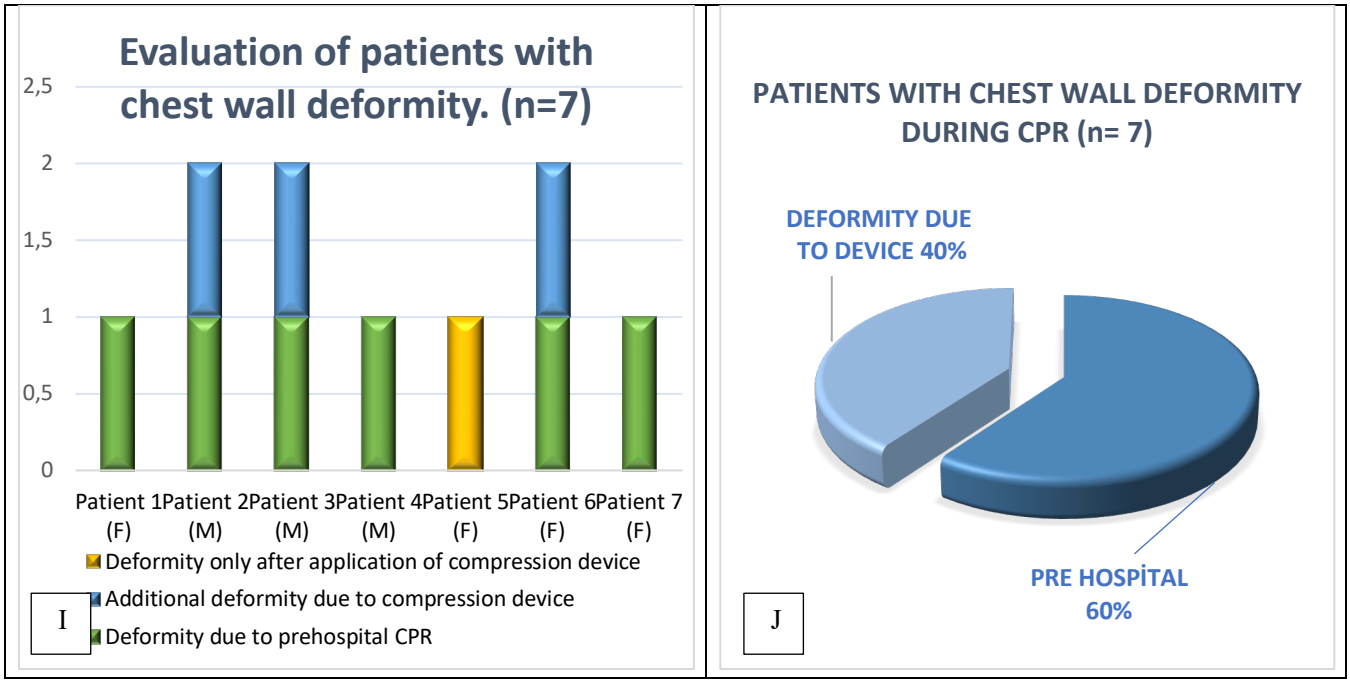

Table 5.

I) Evaluation of patients with chest wall deformity in terms of application types. (n=7) **J)** Evaluation of patients with chest wall deformity. (n=7)

When the deformations of the patients' chest wall during CPR were evaluated (such as rib fracture, sternum fracture, sternum depression, open injury, skin deformity, desquamation, hematoma), it was observed that deformation developed as a result of prehospital chest compression application in 6 patients.

In 3 of these patients, additional deformation developed while continuing chest compression with CEPER chest compression device after admission to the hospital. When the deformations are examined; It was observed that skin

desquamation occurred in 1 patient, and sternum depression deepened due to existing rib fractures in 2 patients. Apart from these patients, it was observed that there was no deformation due to the application of chest compressions before the hospital in 1 patient. After the application with CEPER chest compression device, it was observed that desquamation, erythema and subcutaneous edema developed in the skin fold areas of the anterior chest wall.

When we look at the literature, it is mentioned in the research of Tomasz Kłosiewicz et al. that the use of chest compression device by prehospital emergency teams may have positive effects on the return of spontaneous circulation. (1) Although animal experiments report positive results (2), there are different opinions regarding the use of mechanical chest compression devices in the hospital, there is not enough evidence for their routine use or non-use in the hospital and emergency departments. (3) One of the results we observed in our patients in this study was as follows; The probability of return of spontaneous circulation was significantly higher in patients with a prehospital stay time of less than 4.5 minutes compared to patients in whom this duration exceeded 10 minutes. These results were similar to data reported in previous studies in the literature. (4) Another issue related to the use of chest compression devices is the deformity of the chest wall. Some studies suggest that mechanical compression devices may cause more deformation of the chest wall.

While evaluating the patient data in our case series, we noticed the following result; If chest deformity occurred during manual compression before using a mechanical chest compression device, subsequent use of the device may increase this deformation. However, if there is no deformity when compression is applied to the patient with a chest compression device, then the risk of deformity development is very low. This situation was thought to be related to the personal characteristics of the patients. Randomized controlled studies are needed to decide whether chest compression is due to device-induced or manual compression and to determine whether there is a superiority.

As a result; Although effective and uninterrupted chest compressions are of great importance in the success of CPR and return of spontaneous circulation, factors such as prehospital stay in arrest, early endotracheal intubation and oxygenation are as important as effective chest compressions in the survival of patients. Determining the effect of each of these factors on survival will only be possible by standardizing other factors and patients, and by conducting randomized controlled studies in this way.

Referances

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