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# Echocardiography Role in Estimating the Prognosis of Successfully Resuscitated Patients Using Wall Motion Characteristics

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## Abstract

Introduction: A Large number of patients undergoing cardiopulmonary resuscitation may eventually have poor prognosis because of the underlying conditions, or the complications of current resuscitation or other regenerative processes. The goal of this study was to find an estimation way of prognosis of these patients. Materials and Methods: The study is performed as case series of the patients who undergone cardiopulmonary resuscitation at Rasoul-e Akram hospital, Firoozgar hospital and Haft-e Tir hospital in Tehran. These patients who had successful resuscitation based on the ROSC criteria, regardless of the duration of cardiopulmonary resuscitation, under gone echocardiography for up to 24 hours after the cessation of cardiopulmonary resuscitation. Wall motion pattern (abnormality) of ventricular septum, E-point septal separation (EPSS), inferior vena cava diameter, portal venous gas and patient survival up to 24 hours after resuscitation is determined. Finally, we asked if there is any statistically significance between the relation of cardiac wall motion abnormality and prognosis of the patients. Results: 50 patients were studied in this study. Of these patients, 28 ones survived, and 22 patients did not survive. These 50 patients have mean age of 55.52 years with standard deviation of 23.53, and 1.5 to 91 years old. Duration of survival for the patients was 2 to 70 minutes, and the mean survival time was 16.74 ± 18.46 min. The mean ejection fraction was 26.74 ± 18.26, ranging from 10 to 70. It is shown that there is no statistically significant relation between echocardiographic findings and the patient survival ($P < 0.05$). Conclusion: Based on this study considering all aspects, it can be concluded that echocardiographic findings of cardiac wall motion patterns, cannot be used as a prognostic factor of survival of the patients undergone cardiopulmonary resuscitation. Also, according to the results, it does not seem that patients need to be transferred to perform echocardiography after cardiopulmonary resuscitation. However, further studies are recommended in this area.

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## Introduction

Just after successful cardiovascular resuscitation further actions and care is needed for the patient to survive. Its' timing is indicated by the patient's stability and sustainability, which in many cases is ensured only through reliable criteria

Furthermore, rescue team assistants and nurses often need to know the prognosis of the patient to organize the care given to the patient. Also, in a crowded emergency department, it is important to prioritize services given to different patients that may be present simultaneously there in the resuscitation room. Patients with poor prognosis are sometimes not in the top priority to receive some services compared to the patients with better prognosis, which may frankly benefit from that service.

The decisions made by the doctor as supervisor of the resuscitation team are decisive.

The criteria for assessing cardiac function are used to determine the prognosis of patients (Cicala et al., 2007). Occurrence of local cardiac wall motion abnormalities has always been one of the most prominent criteria for the incidence of cardiac dysfunction (PART, 2014). Radiological findings in cardiac echocardiography can be a determining factor in the evaluation of patients' heart.

## Methods:

This is a cross-sectional study accomplished on the patients who successfully resuscitated from cardiovascular disease in the emergency department at three hospitals in Tehran for two years (Rasoul-e Akram, Firoozgar and Haft-e Tir hospital). Echocardiography was done for up to 24 hours at the emergency department, regardless of the duration of the resuscitation process and wall motion findings in terms of "decreased motion", "no motion" and "abnormal motion" and also ejection fraction, E-point septal separation, inferior vena cava diameter and portal venous gas was documented.

Successfully resuscitated patients were monitored in terms of need for rehabilitation, cardiopulmonary resuscitation or new organ damage, during the same hospitalization.

SPSS v.22 software was used. Relationship between the quantitative variables in qualitative groups was tested by the T-test and Anova, and the relationship between the qualitative and quantitative variables was tested by the Chi-square test.

## Results:

There are 50 patients studied through this study. The average age was 55.52 years (standard deviation 23.57 years) and range from 1.5 to 91 years. Of these, 28 patients survived and 22 patients

died within 24 hours of successful resuscitation.

Duration of resuscitation of patients was 2 to 70 minutes. The mean resuscitation duration was 16.74 ± 18.46 minutes. The mean Ejection Fraction was 26.47 (± 18.26).

Demographic findings and other echocardiographic findings is demonstrated in the table below:

Table 1: Demographic and echocardiographic factors among patients

| Variable | | Survive (+) N=22 | | Survive (-) N=28 | | P-value |
|---|---|---|---|---|---|---|
| | | Mean (Number) | SD (Percent) | Mean (Number) | SD (Percent) | |
| Age (year) | | 63.45 | 18.11 | 49.28 | 25.72 | .033* |
| Duration of CPR (Minutes) | | 17.95 | 12.93 | 15.79 | 14.83 | .584* |
| EF (%) | | 27.82 | 15.79 | 25.89 | 20.23 | .715* |
| PCH | Yes | 10 | 45.46 | 9 | 32.14 | .080** |
| | No | 8 | 36.35 | 18 | 64.29 | |
| | Unknown | 4 | 18.19 | 1 | 3.57 | |
| LV | Normal | 5 | 22.73 | 6 | 21.43 | .246** |
| | Hypokinesia | 15 | 68.18 | 20 | 71.43 | |
| | Dyskinesia | 2 | 9.10 | 0 | 0.0 | |
| | Akynesia | 0 | 0.0 | 2 | 7.14 | |
| RV | Normal | 9 | 40.9 | 7 | 25.0 | .260** |
| | Hypokinesia | 13 | 59.1 | 19 | 67.86 | |
| | Akynesia | 0 | 0.0 | 2 | 7.14 | |
| EPSS | <7 mm | 15 | 68.18 | 7 | 25.0 | .002** |
| | >=7 mm | 7 | 31.81 | 21 | 75.0 | |
| HPVG | present | 2 | 9.1 | 0 | 0.0 | .189** |
| | absent | 20 | 90.9 | 28 | 100 | |
| IVC | <10 mm | 2 | 9.1 | 10 | 35.71 | .069** |
| | 10 - 20 mm | 16 | 72.73 | 16 | 57.14 | |
| | > 10 mm | 4 | 18.19 | 2 | 7.14 | |

*T-test, **Chi-square test

EPSS: E-point septal separation ,HPVG: Hepatic portal venous gas, LV: Left ventricle, RV: Right ventricle

The results showed that the mean age in patients who survived was significantly higher than those who did not survive (P = 0.033).

Echocardiographic findings such: ejection fraction (P = 0.712), left ventricular wall movements (P = 0.246), right ventricular wall movement (P = 0.260), presence of portal vein gas (P = 0.187), inferior vena cava diameter (P = 0.069), there is no statistical significance between the two groups. Of the E-point septal separation, patients with measures equal or more than 7 millimeters were more in the non-survived group than the survived group (P=0.02).

## Conclusion:

The aim of the study was to find a way to estimate the prognosis of patients who under gone cardiopulmonary resuscitation. As the hypothesis of the study it was suggested that the echocardiographic findings could have been a predictive factor for the prognosis of the patients. But the results of the study showed that there is no statistical significance between the group of survivors and the group of non-survivors, according to the echocardiographic findings.[1-3]

In advanced disciplines, the survival rate of cardiac arrest inside and outside of the hospital is less than 30% and less than 10% respectively (Mutchner L, 2007). Cardiac monitoring, experienced

specialist attendance, cardiopulmonary resuscitation at official hours, rapid onset of cardiopulmonary resuscitation especially chest massages and early intubation are the factors that increase the survival of patients (Pembeci et al., 2006). Surveillance of patients during the first 24 hour after cardiopulmonary resuscitation is an important indicator to estimate the prognosis of patients' surveillance. The ultimate goal of cardiopulmonary resuscitation is to remain a healthy and mighty person [4,5].

Dabbagh et al in "Comparison of patients' short-term survival after cardiopulmonary resuscitation in the emergency department of Ayatollah Taleghani and Shahid Modarres hospitals in Tehran" showed that 24 Hours survival rate of patients following cardiopulmonary resuscitation in Ayatollah Taleghani Hospital and Shahid Modarres Hospital was 13% and 26.26% respectively [(6)].

Based on previous studies, the diversity of the short-term survival rates among the patients in the first 24 hours after cardiopulmonary resuscitation may be due to the differences in the type of patients, the amount of facilities or experiences of the staff, the interval to start resuscitation, the quality of performing resuscitation and the presence of trained staff [7].

Recent years following improvements in cardiopulmonary resuscitation and advanced medical care the survival rate of patients with cardiac arrest has dramatically increased. This progress is obvious in the developing countries [8,9].

In a study in Singapore between 2001 and 2014, it was found that geographically different points differ in the prevalence of cardiac arrest [10, 11].

Recovery of organs' circulation is the most important post resuscitation concern [12]. Brain is the most important organ in this situation. Effective cardiac function is the mainstay of providing the circulation. One of the indices of effectiveness of cardiac function is wall motion parameters of heart. According to the studies wall motion abnormalities, even in people with no obvious cardiovascular disease, will increase risk of cardiovascular morbidity or morbidity for about 2.4 to 3.4 times [13]. Wall motion abnormality on the LAD pathway is in direct relationship with the increase the mortality rate and non-lethal myocardial infarction [14]. Attention to new onset cardiac wall motion abnormality is to be noted.

A study in 2001 showed that WMSI (Wall Motion Score Index) was similar to RNV (Radio Nucleic Ventriculography) in prediction of prognosis of acute myocardial infarction. It's much faster and easier to calculate WMSI [15].

A study in 2006 showed that both the LVEF (left ventricular Ejection Fraction) and WMSI (Heart Rate Score Index) provide valuable prognostic information for heart failure, and the WMSI, in this regard, has more power over LVEF [16].

Hepatic portal venous gas (HPVG) has tubular branched view that is formed by accumulation of gas in the upper right abdomen. It often occurs in the context of intestinal infarction. This view is also seen in patients undergone cardiopulmonary resuscitation which is formed when during resuscitation the stomach dilates and gastric emphysema occurs (probably by mal-positioning of neck before intubation for bag-mask ventilation.)

A study has shown that hepatic portal venous gas is more seen in patients who had longer resuscitation and will have lower chance of ROSC (Return of spontaneous circulation), lesser survival rate after hospitalization or discharge and overall prognosis of HPVG is worse.

In this study, the surviving patients have significantly higher mean age than those who did not survive 24 hours post resuscitation (P = 0.033). Other echocardiography factors such as ejection fraction (P = 0.712), left ventricular wall motion abnormality (P = 0.246), right ventricular wall motion abnormality (P = 0.260), presence of portal venous gas in the (P = 0.187) and inferior vena cava diameter (P = 0.069) was not significantly different in the two groups.

Another factor determined by echocardiography is EPSS (E point septal separation) that can be considered in determining the prognosis of patients after resuscitation. EPSS is the distance between the anterolateral mitral valve and the interventricular septum at the beginning of the diastole.

In the early stages of diastole the anterior mitral cusp should be close to the septum or even in contact with it. In the systolic dysfunction an increase in preload causes the anterior mitral cusp to get away from the septum. It has been shown that there is a strong correlation between increasing EPSS and decreasing ejection fraction (EF) [17].

EPSS is measured in M-mode in the PSLA view as the closest distance of anterior mitral cusp from the septum at the beginning of diastole.

Previous studies determined the border of > = 7 mm for EPSS in identifying left ventricular dysfunction (similar to EF <30%).

The results of this study showed that when EPSS was >=7 mm, the non-survivors were significantly higher (P = 0.02). This finding can confirm the past studies and the hypothesis that EPSS has more prognostic value than other echocardiographic parameters. However, according to the findings of this study, regarding the interpretation of the predictive value of echocardiographic parameters on the prognosis of patients undergoing cardiopulmonary resuscitation cannot be definitively considered and further studies seem necessary.

Measures such as the general education of the fundamentals of cardiopulmonary resuscitation, the reduction of the response time of emergency medical centers, the provision of ambulances, advanced education training for medical staff and the formation of a coherent group for cardiopulmonary resuscitation can improve

the efficiency of cardiopulmonary resuscitation and increase survival rate.

As limitations of this study is that it was confined only to three centers. This is a descriptive study thus the limitations of descriptive studies and low sample size are also valid for our study.

Based on the results of the study considering all aspects, it can be concluded that echocardiographic evaluation of cardiac wall motion cannot be considered as an indicator for determining the prognosis of patients undergone cardiopulmonary resuscitation. Also, according to the results, it is no need to transfer the patients to perform echocardiography after cardiopulmonary resuscitation. However, further studies are recommended.

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