Resuscitation 102 (2016) 105–109

Contents lists available at ScienceDirect

Resuscitation

journal homepage: www.elsevier.com/locate/resuscitation

Clinical paper

Benefits of cardiac sonography performed by a non-expert sonographer in patients with non-traumatic cardiopulmonary arrest☆

Suat Zengin[a,*], Erdal Yavuz[a], Behçet Al[a], Şener Cindoruk[a], Gökhan Altunbaş[b], Hasan Gümüşboğa[a], Cuma Yıldırım[a]

[a] Department of Emergency Medicine, Gaziantep University School of Medicine, Gaziantep, Turkey
[b] Department of Cardiology, Gaziantep University School of Medicine, Gaziantep, Turkey

ARTICLE INFO

Article history:
Received 8 September 2015
Received in revised form 15 February 2016
Accepted 25 February 2016

Keywords:
Cardiopulmonary arrest
Cardiopulmonary resuscitation
Cardiac sonography
Pulseless electrical activity

ABSTRACT

The purpose of this study was to evaluate a rapid cardiac ultrasound assessment performed by trained non-expert sonographers integrated into the advanced cardiac life support (ACLS).

Material and methods: This study was prospectively performed in 179 patients (104 males and 75 females) who underwent cardiopulmonary resuscitation (CPR) in an emergency department (ED) during two calendar years (2013 and 2014). Two senior doctors, who had received emergency cardiac ultrasonography training, performed cardiac ultrasound through the apical, subxiphoid, or parasternal windows. Ultrasound evaluation and pulse controls were performed simultaneously. SPSS 18.0 was used for statistical analysis.

Results: A total of 63.7% (114) of the cardiopulmonary arrest incidents occurred out of the hospital. Only 13 patients had a femoral pulse during the initial evaluation, while 166 showed no femoral pulse. Initial monitoring showed a regular rhythm in 53 patients, ventricular fibrillation in 18 patients, and no rhythms in 108 patients. The first evaluation with ultrasound detected an effective heart rate in 26 patients and ventricular fibrillation in 14 patients, while no effective heart rate was observed in 139 patients. In addition, ultrasound revealed pericardial tamponade in seven patients and right ventricular enlargement in four cases. Global hypokinesia was detected in four patients and hypovolemia was observed in another four patients.

Conclusion: The use of real-time ultrasonography during resuscitation with real-time femoral pulse check can help facilitate the distinguishing of pea-type arrest, ascertain the cause of the arrest, infer a suitable treatment, and optimize medical management decisions regarding CPR termination.

Introduction

In recent years, the use of ultrasonography (USG) for diagnostic and therapeutic purposes in EDs has increased rapidly. The American College of Emergency Physicians first published a comprehensive guide for USG use in emergency services in 2001,[1] and the scope of such usage was extended when this guideline was updated in 2009.[2]

Resuscitating patients in cardiopulmonary arrest (CPA) is performed in accordance with the algorithms determined by the American Heart Association (AHA) and the European Resuscitation Council (ERC),[3,4] both of which emphasize the importance of rapid identification of potentially reversible or treatable causes of CPA.

A clear distinction between asystole and true-false pulseless electrical activity must be made. True pulseless electrical activity (TPEA) is seen in settings of prolonged cardiac arrest, as well as in scenarios that involve metabolic derangements, hypothermia, or poisoning. In cases where TPEA is detected, the resuscitation approach is more aggressive.[5,6] For health professionals, the absence of a pulse detected with the hand is a primary indication for initiating chest compressions in patients considered to have CPA. However, using pulse control to evaluate perfusion during CPA may be associated with some risks of its own.[7–9] A visible rhythm on the monitor, along with the absence of a pulse, does not always indicate the presence of TPEA. It is difficult to evaluate pulse activity in cases such as pericardial tamponade, pulmonary embolism, pneumothorax, and hypovolemia, even when there is

☆ A Spanish translated version of the summary of this article appears as Appendix in the final online version at http://dx.doi.org/10.1016/j.resuscitation.2016.02.025.

* Corresponding author at: Emergency Department of Medicine Faculty, Gaziantep University, Gaziantep, Turkey.
E-mail address: zengins76@gmail.com (S. Zengin).

http://dx.doi.org/10.1016/j.resuscitation.2016.02.025
0300-9572/

cardiac contraction.[10] These are common causes of false pulseless electrical activity (FPEA) and can easily be diagnosed with cardiac USG.[11–13]

Rapid identification and correction of reversible causes may improve the outcomes in cardiac arrest. The importance of cardiac USG in the identification of reversible causes of cardiac arrest was emphasized in the 2015 ERC guidelines.[14] This study seeks to evaluate the performance and reliability of a rapid cardiac ultrasound assessment performed by trained nonexpert sonographers integrated into the ACLS.

Materials and methods

The study was conducted according to a detailed protocol that conforms to the STARD (Standards for the Reporting of Diagnostic Accuracy Studies) guidelines[15] at the Department of Emergency Medicine of Gaziantep University, from January 2013 to December 2014. The study protocol conformed to the principles of the Declaration of Helsinki, and was approved by the Medical Ethics Committee (Ethical committee resolution no: 14.05.2012/203, date 14.05.2012).

The study was performed without gender discrimination in adults aged over 16 years with non-traumatic cardiac arrest. We enrolled 179 of the 264 CPA patients who underwent resuscitation in Gaziantep University Faculty of Medicine (Fig. 1). Logiq P6 (GE Healthcare, 2008) was used as the USG device, and examination was performed with a tightly curved array probe (2–4 MHz) in 2D mode. The USG device was kept ready and available in the resuscitation room throughout the duration of the study. Two senior doctors, who had received 16 h of theoretical and applied focused echocardiography training and 8 h of basic emergency ultrasonography training performed all USG examinations. These doctors were responsible only for performing USG. We defined sonographic evidence of cardiac kinetic activity as any detected motion of the myocardium, ranging from visible ventricular fibrillation (VF) to coordinated ventricular contractions.

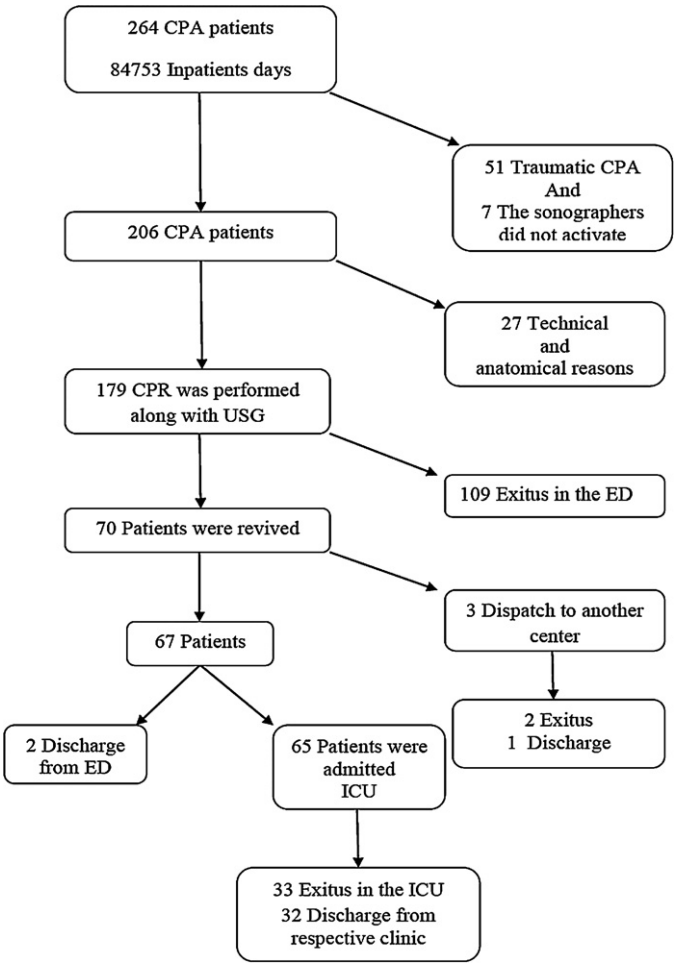

Fig. 1. Flow chart of the study. CPA, cardiopulmonary arrest, USG, Ultrasonography, ED, emergency department, ICU, intensive care unit.

For the USG evaluations, patients were monitored by the USG team at the first, second, and third inspections, through the apical, subxiphoid, or parasternal windows, while resuscitation was being performed and the femoral pulse was checked in real time. All inspections were completed in 10-s spans. More detailed USG was performed when rhythm had returned to normal or when the patient was accepted exitus. In the case of shockable rhythms (VF, pulseless ventricular tachycardia), USG was performed without delay (in 10-s spans), while the defibrillator was being charged.

Standard forms were used to record patient age, gender, whether arrest had occurred out-of-hospital or during follow-up in hospital, respiration on arrival, the way in which upper airway control was provided, the state of vascular access, and the duration of CPR. The femoral pulse of all patients was evaluated during the heart-rate beat moment on the monitor, and with USG in the fifth minute of CPR, and when there was a response to CPR or before CPR was terminated. Findings were recorded on the forms. In addition, ultrasound images were recorded and, also later the images were evaluated by a cardiology doctor. All data were evaluated with SPSS Ver. 18.0 (SPSS Inc., Chicago, Illinois, USA) software. The relationship between variables was analyzed using the Pearson Chi-Square correlation test. In all comparisons, $p < .05$ was considered statistically significant.

Results

Of the 206 patients in whom CPR was performed along with USG, 179 patients were enrolled in the study. The rate of out-of-hospital cardiac arrest was 63.7% ($n = 114$), and the rate of CPA during in-hospital care was 36.3% ($n = 65$). The mean age of the patients was 62.8 ± 16.4 (19–85) years, and 104 (58.1%) were males (mean age: 62.7 ± 15 years), while 75 (41.9%) were females (mean age: 62.9 ± 18.3 years). The gender and ages of the patients are outlined in Table 1, and the airway, vascular access, femoral pulse, and respiration conditions of the patients at the initiation of CPR are described in Table 2.

There was a significant correlation between femoral pulse checks and USG wall motion ($p < .05$ for all inspections). In the first evaluation, 42 patients were accepted as having pulseless electrical activity (PEA). However, USG examination revealed that 13 of these patients actually had FPEA. Likewise, 14 of 32 patients who had been accepted as having PEA in the second evaluation were shown to have FPEA, and four of seven patients who had been accepted as having PEA in the third evaluation were shown to have FPEA.

Five patients were initially diagnosed as having VF in the first evaluation, but USG examination then revealed that these patients

Table 1
Age and gender of patients according to admission status.

Admission type		N	%	Age (years)
Arrest during follow-up	Male	34	52.3	65.2 ± 17
	Female	31	47.7	66.2 ± 17
	Total	**65**	**100**	**65.7 ± 16.7**
Out of hospital arrest	Male	70	61.4	61.4 ± 14
	Female	44	38.6	60.5 ± 19
	Total	**114**	**100**	**61 ± 16**