Contents lists available at ScienceDirect

Resuscitation

EUROPEAN
RESUSCITATION
COUNCIL

Short paper

Point-of-care ultrasound use in patients with cardiac arrest is associated prolonged cardiopulmonary resuscitation pauses: A prospective cohort study

Eben J Clattenburg [a,*], Peter Wroe [a], Stephen Brown [b], Kevin Gardner [a], Lia Losonczy [a], Amandeep Singh [a], Arun Nagdev [a,b]

[a] Department of Emergency Medicine, Highland Hospital—Alameda Health System, Oakland, CA, United States
[b] School of Medicine, University of California, San Francisco, CA, United States

ARTICLE INFO

ABSTRACT

Objective: We aim to evaluate if point-of-care ultrasound use in cardiac arrest is associated with CPR pause duration.

Methods: This is a prospective cohort study of patients with cardiac arrest (CA) presenting to an urban emergency department from July 2016 to January 2017. We collected video recordings of patients with CA in designated code rooms with video recording equipment. The CAs recordings were reviewed and coded by two abstractors. The primary outcome was the difference CPR pause duration when POCUS was and was not performed.

Results: A total of 110 CPR pauses were evaluated during this study. The median CPR pause with POCUS performed lasted 17 s (IQR 13 – 22.5) versus 11 s (IQR 7 – 16) without POCUS. In addition, multiple regression analysis demonstrated that POCUS was associated with longer pauses (6.4 s, 95%CI 2.1- 10.8); ultrasound fellowship trained faculty trended towards shorter CPR pauses (-4.1 s, 95%CI −8.8–0.6) compared to non-ultrasound fellowship trained faculty; and when the same provider led the resuscitation and performed the POCUS, pause durations were 6.1 s (95%CI 0.4 −11.8) longer than when another provider performed the POCUS.

Conclusion: In this prospective cohort trial of 24 patients with CA, POCUS during CPR pauses was associated with longer interruptions in CPR.

Introduction

Cardiac arrest (CA) with non-shockable rhythms continues to have poor outcomes [1]. The American Heart Association now recommends point-of-care ultrasound (POCUS) to evaluate for reversible causes of CA, and recent studies have shown that POCUS can show evidence of hypovolemia, cardiac tamponade, and pulmonary embolism (PE) [2–5]. One survey found that emergency physicians (EP) frequently employ POCUS during cardiac arrest [6].

Animal and human data have demonstrated the importance of high quality CPR, specifically limiting pauses, in order to maximize the likelihood of return of spontaneous circulation (ROSC) [7–9]. While studies have shown that experienced providers may be able to perform POCUS in <10 s, only 1 study has evaluated the association between CPR pause duration and POCUS in ED CA [2,3,5,10–12]. In this prospective cohort study, we evaluated if POCUS during CA resuscitation is associated with increased CPR pause duration. We hypothesized that POCUS is associated with prolonged interruptions in CPR.

Methods

Study settings

This prospective cohort study was performed at an urban emergency department (ED) with an Emergency Medicine residency program. A paramedic based EMS system provides advanced life support (ALS) in the field. The hospital's institutional review board approved this study.

* Corresponding author at: Eben Clattenburg Highland Hospital Department of Emergency Medicine 1411 East 31st St. Oakland, CA 94602, United States.
E-mail address: eclattenburg@alamedahealthsystem.org (E.J. Clattenburg).

Table 1
Patient and code characteristics comparing cases included and excluded from the analysis.

	Recorded (n = 24)	Not Recorded (n = 58)	p-value[a]
Age, median (IQR)	65.5 (59–73.5)	65 (56 – 74)	0.72
Sex, n (%)			
Male	15 (62.5)	35 (60.3)	
Female	10 (37.5)	22 (39.6)	0.98
Comorbidities%			
HTN	54.2	46.6	0.54
DM	25.0	20.7	0.65
CAD	20.8	25.8	0.63
HLD	8.3	12.0	0.63
ESRD	16.7	13.8	0.72
Initial rhythm n (%)[b]			
Non-shockable	16 (66.7)	43 (75.4)	
Shockable	8 (33.3)	14 (24.6)	0.42
OHCA n (%)	23 (95.8)	47 (81.0)	0.09
Witnessed Cardiac Arrest n (%)[c]	15 (65.2)	30 (62.5)	0.83
Bystander CPR%	52.2	43.8	0.51
ROSC in ED			
No	18 (75.0)	39 (67.2)	
Yes	6 (25.0)	19 (32.8)	0.45
Total CPR pauses, n	110	n/a	
Total pulse checks, n	86	n/a	
Total POCUS performed, n	59	n/a	
CPR pauses per code, mean (SD)	4.5 (3.5)	n/a	
Pulse checks per code, mean (SD)	3.6 (2.2)	n/a	
Number of POCUS during CPR pauses by code, mean (SD)	2.5 (1.7)	n/a	

HTN, hypertension; DM, diabetes mellitus; CAD, coronary artery disease; HLD, hyperlipidemia; ESRD, end stage renal disease; OHCA, out of hospital cardiac arrest; ROSC, return of spontaneous circulation.

[a] n = 81: one patient without video did not have initial rhythm documented.
[b] Fisher's exact was used for categorical outcomes and student *t*-tests and Mann-Whitney *U* tests were used for continuous outcomes.
[c] n = 23 among recorded videos and n = 48 among not recorded videos because of incomplete EMS documentation.
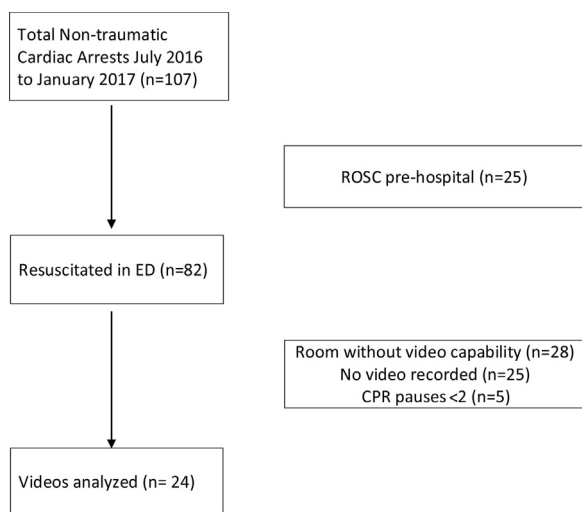
Fig. 1. Consort diagram of participants enrolled in the study.

Participants

All patients presenting to the ED for CA or experiencing CA in the ED from July 2016 to January 2017 were considered for this study. The exclusion criteria included traumatic arrests, patients with ROSC prior to ED arrival, if fewer than two CPR pauses were performed, or if the video of the resuscitation was not recorded.

Study outcomes

The primary outcome was the difference in CPR pause duration when POCUS was and was not performed. CPR pauses were defined as any interruption in CPR greater than 3 s after which CPR was resumed (excluding moments of obvious intermittent ROSC) consistent with prior research [13]. Other variables of interest included: provider training level (resident year and if the attending had completed an ultrasound fellowship); if the same provider led the code and performed the POCUS; patient data (demographics, comorbidities); and basic code data (initial rhythm, witnessed arrest or not, bystander CPR, and ROSC).

Data collection

A list of CA's was created from the list of EMS "ring downs" for medical codes, patients with a documented chief complaint of diagnosis of "cardiac arrest", and patients with a final disposition to morgue, ICU, or cardiac catheterization lab.

Staff members turned on overhead video cameras in two medical resuscitation bays at the start of resuscitations. Codes were recorded 24 h a day, 7 days a week. Videos of the resuscitations were stored in a secure hospital database.

A standardized data abstraction tool was created and trialed on 3 videos not included in this study. Two reviewers separately watched and coded all study videos for CPR pause duration, reason(s) for pause, whether ultrasound was performed during the pause, and which provider performed the ultrasound. All coding differences were re-watched for consensus.

Statistical analysis

We performed descriptive statistics of patient and code data. Baseline differences were evaluated with Fisher's exact and student *t*-test analyses. The association between CPR pause length with POCUS, intubation, attending ultrasound fellowship training, resident training year, and automated compression device were examined with univariable and multivariable linear regression. The multivariable analysis controlled for: resident year, use