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Clinical paper

Seizure-like presentation in OHCA creates barriers to dispatch recognition of cardiac arrest

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Abstract

Purpose: Early recognition of out-of-hospital cardiac arrest (OHCA) by 9-1-1 dispatchers is a critical first step along the resuscitation pathway. Barriers to recognition may lead to adverse outcomes among patients. This study aims to determine the impact of seizure-like activity among OHCA patients during 9-1-1 calls.

Methods: We evaluated a retrospective cohort study of all adult, non-traumatic OHCAs that occurred prior to emergency medical services (EMS) arrival on scene in a major metropolitan area from 2014–2018. Dispatch recordings were reviewed to determine if seizure-like activity was reported by the caller using key descriptor phrases such as "seizing," "shaking," or "convulsing." We compared patient demographics, arrest factors, and hospital outcomes using a regional OHCA quality improvement database.

Results: Among 3502 OHCAs meeting our inclusion criteria, 149 (4.3%) contained seizure-like activity. When compared to patients without seizure-like activity (3353; 95.7%), patients presenting with seizure-like activity were younger (54 vs. 66 years old; $p < 0.05$), had a witnessed arrest (88% vs 45%; $p < 0.05$), presented with an initial shockable rhythm (52% vs. 24%; $p < 0.05$), and survived to hospital discharge (44% vs. 16%; $p < 0.05$). The seizure-like activity group also had a longer median time to dispatcher identification of the cardiac arrest [130 s (72,193) vs 62 s (43,102); $p < 0.05$].

Conclusions: Reported seizure-like activity among patients in cardiac arrest poses a barrier to recognition of cardiac arrests by dispatchers leading to delays in resuscitation instructions.

Keywords: OHCA, Seizure, Cardiac arrest, Dispatcher, Telephone-CPR, TCPR

Introduction

It is critically important to recognize cardiac arrest as quickly as possible to achieve successful resuscitation for victims of out of hospital cardiac arrest (OHCA).[1] Telephone cardiopulmonary resuscitation (T-CPR) was first used by Phoenix Fire Department in 1975 and later implemented in King County, Washington in 1980 to provide real-time CPR instructions to bystanders to reduce the time from a cardiac arrest to the initiation of CPR.[2–4] Implementation of these programs have improved rates of bystander CPR as well as outcomes from OHCA.[1,3]

Rapidly identifying OHCA, which leads to rapid CPR delivery, can sometimes be problematic.[5,6] Distractors such as the emotional state of the caller and agonal breathing are known causes for delaying the onset of T-CPR.[6] Another potential distractor that may lead to delay is a seizure-like presentation. Stand-alone seizures account for 3–4% of all 9-1-1 calls and may present with abnormal postictal breathing.[7–9] Researchers have discovered that approximately 0.6–2.1% of seizure calls end up as a cardiac or respiratory arrest, and close to 1.8–3% of cardiac arrest cases are initially classified as seizures.[8,10,11] Wrongly classifying these calls as seizure may also lead to lower priority dispatching, delaying appropriate care even further.[12]

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Agonal breathing after cardiac arrest is correlated with positive outcomes for OHCA if CPR begins promptly.[13] However, agonal type breathing in a postictal patient does not require CPR. This commonality in presentation highlights several challenges in distinguishing a seizure from an OHCA with seizure-like activity. The goal of this study is to determine the impact of OHCA associated seizure-like activity on delays in dispatcher recognition of cardiac arrest during 9-1-1 calls.

Methods

This study is a retrospective cohort evaluation including all non-traumatic OHCA cases that occurred before emergency medical services (EMS) in King County Washington, excluding the city of Seattle, from January 1, 2014- December 31, 2018. King County is a major metropolitan area with a population of approximately 1.3 million. This study was approved by the University of Washington Human Subjects Committee and King County Public Health Institutional Review Board (IRB).

Cases were excluded if the patient was a child or considered a protected population due to the original IRB approval. Analysis of these factors was completed using a retrospective chart review. Additional cases were excluded if the cardiac arrest occurred after EMS arrival, if no dispatch recordings were available, or if the arrest happened after the call ended. In these cases, we cannot evaluate how the call receiver assesses the cardiac arrest over the phone. Identified cases were compared to OHCAs meeting inclusion and exclusion criteria without mention of seizure-like activity. Calls were determined to contain seizure-like activity if descriptors such as "seizing," "shaking," or "convulsing" were used sometime during the call.

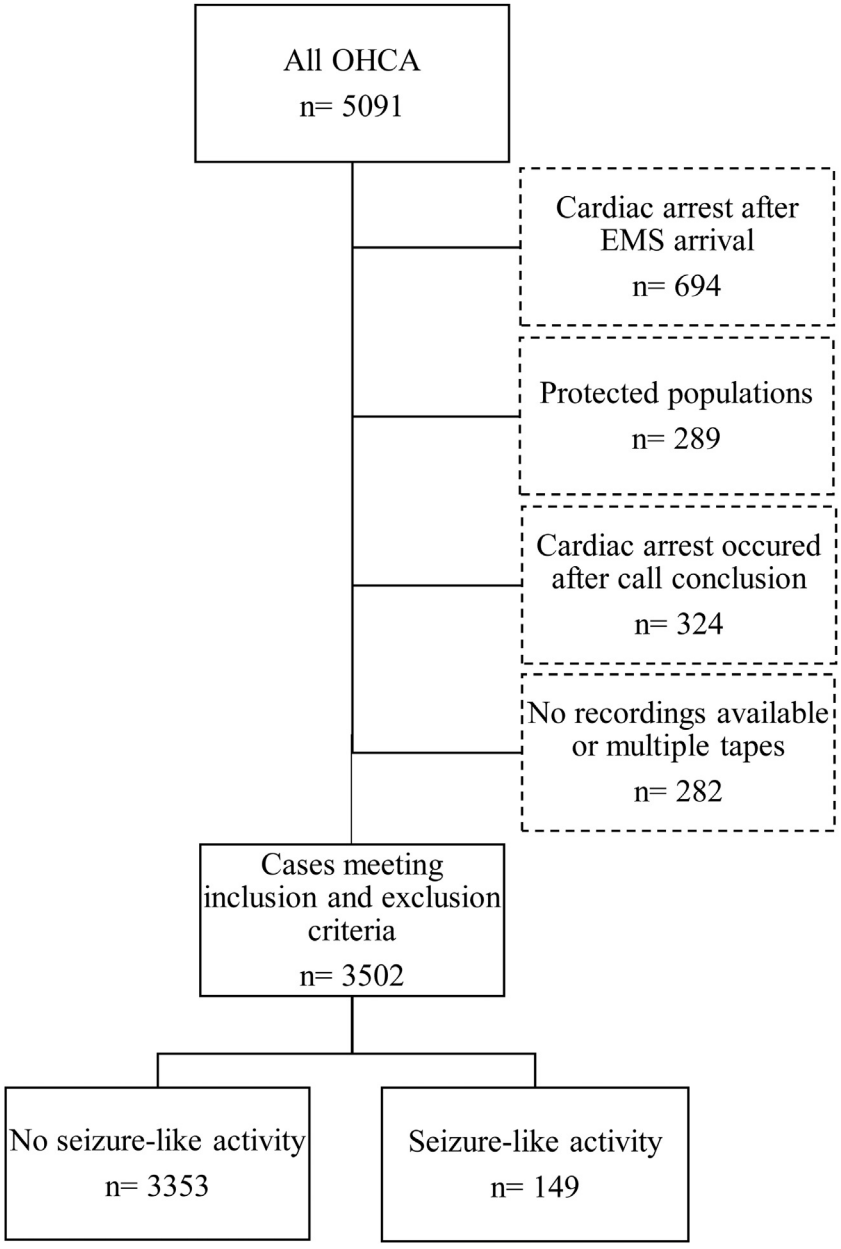

Fig. 1 – Data flow chart.

King County utilizes a two-tiered EMS system. The first tier consists of fire fighter-emergency medical technicians trained in basic life support (BLS) and defibrillation. The second tier consists of paramedics who are trained in advanced life support (ALS). If cardiac arrest is suspected, both ALS and BLS are dispatched simultaneously. The EMS system follows the American Heart Association guidelines for the management of cardiac arrest.

A dispatch protocol was created in King County in 1984 to help dispatchers quickly recognize cardiac arrest and provide CPR instructions to bystanders.[2] The current call receiver protocol in King County is consistent with the AHA guidelines for telephone CPR and begins with the all caller questions of obtaining the caller location and whether the caller is the patient, followed by assessing if the patient is conscious and breathing normally.[14] If a patient is not conscious and not breathing normally, the dispatcher offers bystander CPR instructions to the caller. This quick assessment ensures early recognition of cardiac arrest and the rapid provision of CPR. If a caller states the patient is seizing before the call receiver asks the all caller questions, the call receiver waits until the patient has stopped seizing to assess breathing. Dispatchers repeatedly ask whether the patient is still seizing until the caller confirms the seizure has stopped, at which time the dispatcher reassesses breathing. Current goal standards for OHCA calls include recognizing cardiac arrest within one minute and starting CPR within two minutes.

The EMS division maintains an ongoing registry of treated cardiac arrest since 1976 as part of a regional OHCA quality improvement database. Hospital outcomes are determined from hospital records. Dispatch recordings of cardiac arrest calls have been collected for all cardiac arrest cases since 1990. All OHCA calls are reviewed using a standard TCPR form to collect QI data, including call details, event factors, time to recognizing cardiac arrest, and time to first chest compression. For this study, additional information was abstracted from the seizure-like OHCA cases by one researcher listening to their individual 9-1-1 calls.

Categorical variables were assessed using Pearson's chi-square, and continuous variables were evaluated using the nonparametric test, Mann Whitney U. Analyses were performed using SPSS 20.0.

Results

During the period of January 1, 2014, to December 31, 2018, 3502 cases met our inclusion and exclusion criteria, of which 149 presented with seizure-like activity sometime during the call, and 3353 did not (Fig. 1).

The seizure-like activity group is younger than the non-seizure-like activity group. OHCAs with seizure-like activity were more likely to be bystander witnessed, occur in a public location, present with an initial shockable rhythm, and survive to hospital discharge (Table 1).

For patients with seizure-like activity, there were significant delays in the dispatcher asking if the patient was conscious and breathing normally, establishing the patient as unconscious, and establishing the patient as not breathing normally. The call receiver recognized, and callers reported agonal respirations more often in the seizure-like

Table 1 – Patient demographics and event characteristics.

	Seizure-like activity n = 149 (%)	No seizure-like activity n = 3353 (%)	p-value
Patient demographics			
Sex			**0.06**
Male	108 (72.5)	2197 (65)	
Female	41 (27.5)	1174 (35)	
Age[a]			**0.00**
Median (interquartile range)	54 (45,65)	66 (54,77)	
Event characteristics			
Location[a]			**0.00**
Home	84 (56.4)	2378 (70.9)	
Public (indoor/outdoor)	58 (38.9)	484 (14.4)	
Other[b]	7 (4.7)	491 (14.7)	
Was cardiac arrest bystander witnessed?[a]			**0.00**
Witnessed	131 (87.9)	1523 (45.4)	
Not witnessed	18 (12.1)	1830 (54.6)	
Was bystander CPR performed?			**0.46**
Yes	118 (79.2)	2736 (81.6)	
No	31 (20.8)	617 (18.4)	
Initial arrest rhythm[a]			**0.00**
Shockable	78 (52.3)	817 (24.4)	
Non-shockable	71 (47.7)	2536 (75.6)	
Survived to hospital discharge[a]			**0.00**
Yes	65 (43.6)	551 (16.4)	
No	84 (56.4)	2802 (83.6)	
Neurological outcome (data available for 2015–2018 only)	n = 54 (%)	n = 431 (%)	**0.62**
CPC[c] good (1–2)	51(94.4)	399 (92.6)	
CPC[c] poor (3–4)	3 (5.6)	32 (7.4)	

[a] Statistically significant $p < 0.05$.
[b] medical facility, Skilled nursing facility, assisted living, adult family home, jail, etc.
[c] cerebral performance category.

Table 2 – 9-1-1 Caller questions and arrest recognition.

	Seizure-like activity n = 149 (%)	No seizure-like activity n = 3353 (%)	p-value
Determining consciousness			
Was question delayed?[a]			**0.00**
Yes	34 (37.8)	360 (16.7)	
No	56 (62.2)	1790 (83.3)	
Was consciousness established by call receiver (CR)?[a]			**0.00**
Yes	131(87.9)	3220(96.3)	
No	18 (12.1)	123 (3.7)	
Determining breathing			
Was question delayed?[a]			**0.00**
Yes	65 (70.7)	789 (38.6)	
No	27 (29.3)	1255 (61.4)	
Was breathing established by CR?[a]			**0.00**
Yes	118 (79.2)	3072 (91.9)	
No	31 (20.8)	270 (8.1)	
Median time intervals of 9-1-1 call events (seconds)			
Time to consciousness question[a]			**0.00**
N	113	2896	
Median (interquartile range)	38 (24,61)	28 (19,41)	
Time to breathing question[a]			**0.00**
N	136	2866	
Median (interquartile range)	60 (42,97)	40 (27,60)	
Time to OHCA recognition[a]			**0.00**
N	108	2666	
Median (interquartile range)	130 (72,193)	62 (43,102)	
Time of first chest compression[a]			**0.00**
N	62	1599	
Median (interquartile range)	202 (167,247)	157 (116,215)	
Other call factors			
Did the CR identify agonal respirations?			**0.04**
Yes	29(19.5)	454(13.6)	
No	120(80.5)	2880(86.4)	
Were the agonal respirations reported or described by the caller?[a]			**0.00**
Yes	57(38.3)	595(17.8)	
No	92(61.7)	2753(82.2)	
Was the patient seizing at the time of the call?			
Yes	105(70.5)		
No	38(25.5)		
Unknown	6(4)		
When did seizure occur in relation to the call?			
Prior to call, only	38(25.5)		
Prior to and during call	93(62.4)		
During call only	11(7.4)		
Unknown	7(4.7)		
Time to indication of seizure (seconds)			
N	149		
Median (interquartile range)	16 (9,41)		
Duration of seizure (seconds)			
N	82		
Median (interquartile range)	80 (52,124)		

[a] Statistically significant $p < 0.05$.

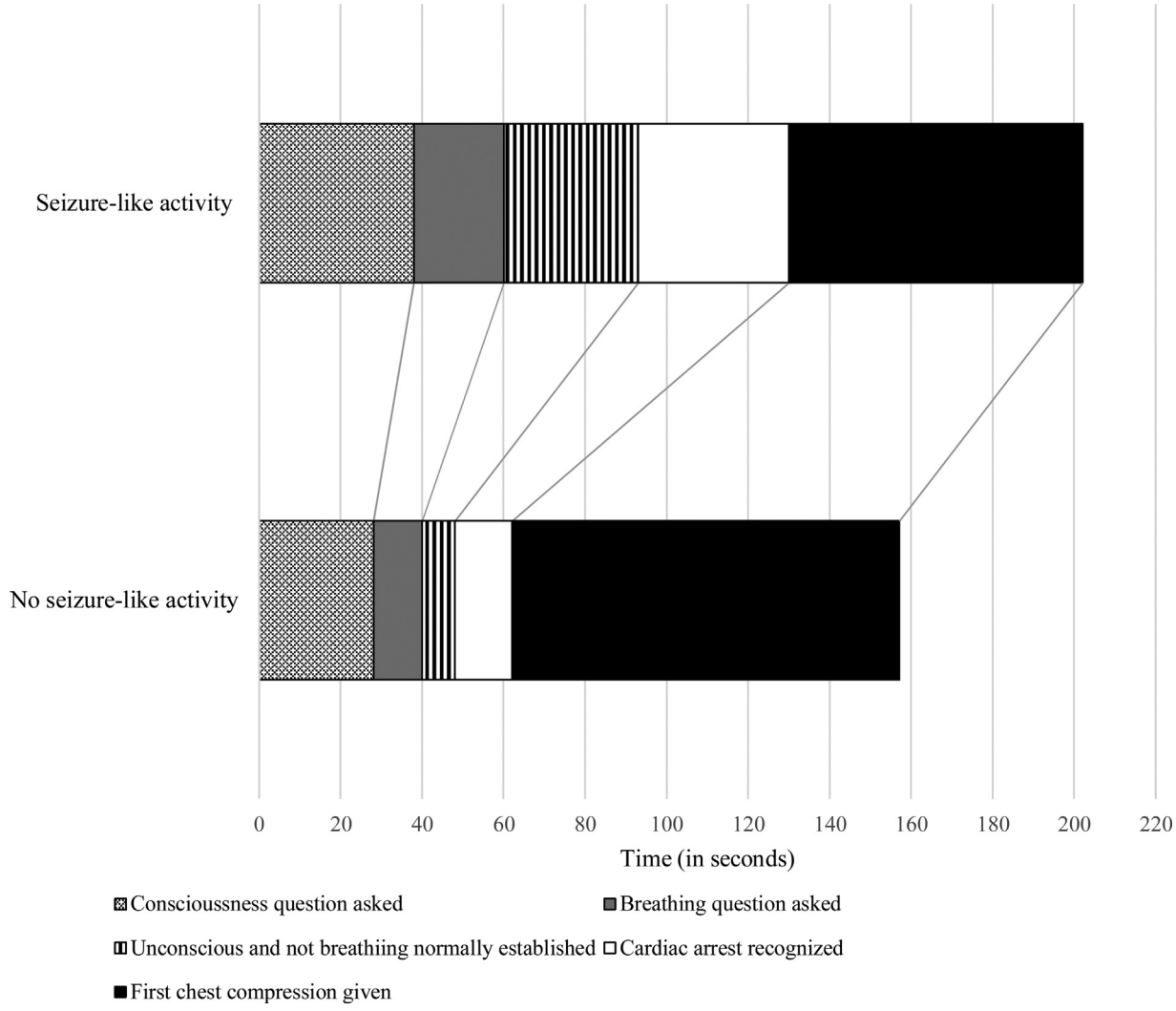

Fig. 2 – Median time intervals of 9-1-1 call events.

activity calls. The seizure-like activity cohort also had a longer median time to dispatcher identification of the cardiac arrest and start of CPR (Table 2) (Fig. 2).

For those patients whose seizure-like activity occurred during the 9-1-1 call, the average activity ceased after a median duration of 80 s (52,124) (Table 2).

In the OHCA with seizure-like activity cohort, patients were often described as having abnormal breathing, particularly gasping, gurgling, and snoring. When asked to describe the patient's seizure, callers described patients as convulsing, shaking, or tense. Descriptions of eyes were open with a blank stare or “eyes are rolling back.” Finally, callers often described patients as turning blue, purple, or red.

Discussion

Our data shows that seizure-like activity during OHCA causes significant delays in recognizing cardiac arrest and providing telephone CPR instructions. Delays in asking and establishing that the patient is unconscious and not breathing normally contribute to this overall delay. By dispatch protocol, call receivers do not ask the breathing question until after a patient has ceased convulsions. Criteria for giving CPR instructions are met when a patient is established as unconscious and not breathing normally. However, a delay remains in dispatchers recognizing cardiac arrest, defined as the call receiver initiating bystander CPR or verbally affirming the diagnosis. This additional delay indicates that added confusion is present in these cases with seizure-like activity.

The seizure-like cohort's general characteristics show that these arrests are more often bystander witnessed, occurring in public, presenting with a shockable rhythm, and surviving to hospital discharge when compared to the no seizure-like activity cohort. So, although there are significant delays in recognizing cardiac arrest and starting CPR among patients with seizure-like activity, the seizure-like cohort has higher survival rates than the cohort with no seizure-like activity. We did not individually control for each upstream factor in this study, which may have impacted the overall outcomes. These factors may explain why although delays are present in dispatchers recognizing cardiac arrest and providing CPR instructions, the seizure-like group has better survival outcomes. Specifically receiving bystander CPR and presenting with a shockable rhythm are factors

especially associated with better survival outcomes.[1,15,16] Earlier CPR will likely improve outcomes even more in the seizure-like activity cohort.[17,18]

Much remains unclear about the differences in presentation of seizure-like activity during cardiac arrest and how we may be able to identify it from a stand-alone seizure. Seizure-like activity was associated with low systolic blood pressures and bradycardia during head-up tilt test (HUT)-induced syncope in a study by Joo et al. They found 47 of 71 (66.2%) patients undergoing HUT had some sort of seizure-like activity, including eye deviation and jerking movements, with 70.2% of those 47 patients showing both.[19] Sudden cardiac arrest is physiologically similar to (HUT)-induced syncope, with the primary problem being a sudden loss of brain perfusion. The short duration of seizure-like activity due to loss of perfusion to the brain or sudden asphyxia seems to be a distinction repeated in the literature. Researchers found these convulsions to last around ten seconds or less and may continue with rigid body posturing of longer duration.[20,21]

Seizure-like activity in these cases occurs quickly after the loss of brain perfusion. Callers would need to have seen the patient go into cardiac arrest, which may explain why a majority of the cardiac arrests with seizure-like activity were bystander witnessed. Prolonged "tense" body posturing was similarly provided by callers in this study when asked to describe the OHCA patient whom they claimed was seizing. Layperson callers may be confused by patient presentations and incorrectly confirm a seizure, delaying breathing evaluation.[22] Confusion from the caller may also have impacted the seizure duration recorded in this study. Duration and timing of seizure-like activity were variable in this study. The exact quality and duration of seizures are challenging to assess over the phone, and a short seizure duration may not be a reliable way to predict if the seizure-like activity is due to cardiac arrest.

Previous papers recommend asking about a history of seizure or epilepsy rather than attempting to evaluate patient signs and symptoms over the phone to predict the underlying origin of the seizure.[23] If the presenting seizure is the first for the victim, it is more likely to be cardiac arrest than if the victim has a history of seizures.

Calls for seizures are common, and dispatchers are aware that patients may have abnormal breathing after a seizure. This similar presentation can be confusing when dispatchers attempt to determine whether abnormal breathing is due to cardiac arrest. Current advice while assessing a postictal patient includes asking whether the breathing is getting better or worse. Agonal respirations were heard by the call receiver and reported by the caller in the seizure-like cohort significantly more than the non-seizure-like cohort. Agonal respirations may be difficult for layperson callers to evaluate. Specific descriptions of breathing such as snoring and gasping, therefore, may help alert call receivers that a patient is in cardiac arrest rather than postictal during breathing evaluation. Additionally, researchers have found that performing bystander CPR on patients who do not require CPR does not happen often, and causes minimal harm to patients, especially when compared to the benefit to patients who do require CPR.[24,25] These findings reinforce the recommendation to provide CPR instructions when abnormal breathing is present in an unconscious postictal patient.

Delays in recognition of cardiac arrest and confusion about seizure-like activity in OHCA are present during 9-1-1 calls. We believe awareness of this presentation will improve cardiac arrest recognition and help distinguish it from actual seizure calls. Education on the demographic characteristics of the cohort with seizure-like activity may help alert dispatchers to cardiac arrest in similar patients. When seizure-like activity is present during a 9-1-1 call, dispatchers should be alerted to the possibility of cardiac arrest, especially when there are agonal respirations or no previous history of seizures. Additionally, all cases presenting with seizure-like activity should include a reassessment of normal breathing due to variability in presentation and confusion by callers and dispatchers. Providing bystander CPR instructions when patients are unconscious and abnormally breathing following a seizure, is the best way to ensure patients who need CPR receive compressions as quickly as possible. We recommend that telephone-CPR training includes the possibility of cardiac arrest for ongoing seizures as part of instruction.

Declaration of interests

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