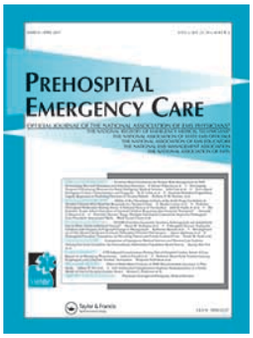

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Case Conferences

CPR Induced Consciousness During Out-of-Hospital Cardiac Arrest: A Case Report on an Emerging Phenomenon

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Abstract

Background: High quality cardiopulmonary resuscitation (CPR) has produced a relatively new phenomenon of consciousness in patients with vital signs absent. Further research is necessary to produce a viable treatment strategy during and post resuscitation. **Objective**: To provide a case study done by paramedics in the field illustrating the need for sedation in a patient whose presentation was consistent with CPR induced consciousness. Resuscitative challenges are provided as well as potential future treatment options to minimize harm to both patients and prehospital providers. **Case Report**: A 52-year-old male presented as a witnessed out-of-hospital cardiac arrest (OHCA). During CPR the patient began to exhibit signs of life including severe agitation and thrashing of his limbs while CPR was ongoing for ventricular fibrillation prior to defibrillation. Resuscitation became considerably more complicated due to the violent and counterintuitive motions done by the patient during their own resuscitation. Despite the atypical presentation of cardiac arrest the patient was successfully resuscitated employing high quality CPR, standard advanced life support (ALS) care as well as two double sequential external defibrillation shocks. The patient underwent emergency percutaneous coronary intervention (PCI) for a 100% occlusion of his left anterior descending artery (LAD). The patient returned home 3 days later fully recovered with a Cerebral Performance Score of 1. **Conclusion**: CPR induced consciousness is emerging as a new phenomenon challenging providers of high quality CPR during cardiac arrest resuscitation. Our case report describes the manifestations of CPR induced consciousness as well as the resuscitative challenges which occur during resuscitation. Further research is required to determine the true frequency of this condition as well as treatment algorithms that would allow for appropriate and safe management for both the patient and EMS providers. **Key words:** cardiac arrest; cardiopulmonary resuscitation; paramedic; CPR induced consciousness

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Introduction

Traditional out-of-hospital cardiac arrest (OHCA) management involves performance of cardiopulmonary resuscitation (CPR) and adherence to current benchmarks for high quality CPR, as noted in the current American Heart Association (AHA)/International Liaison Committee on Resuscitation (ILCOR) guidelines.[1,2] Interestingly, the recent emphasis on high quality CPR with the potential for concomitant improvements in cerebral blood flow have produced some unexpected side effects during cardiac arrest resuscitation.

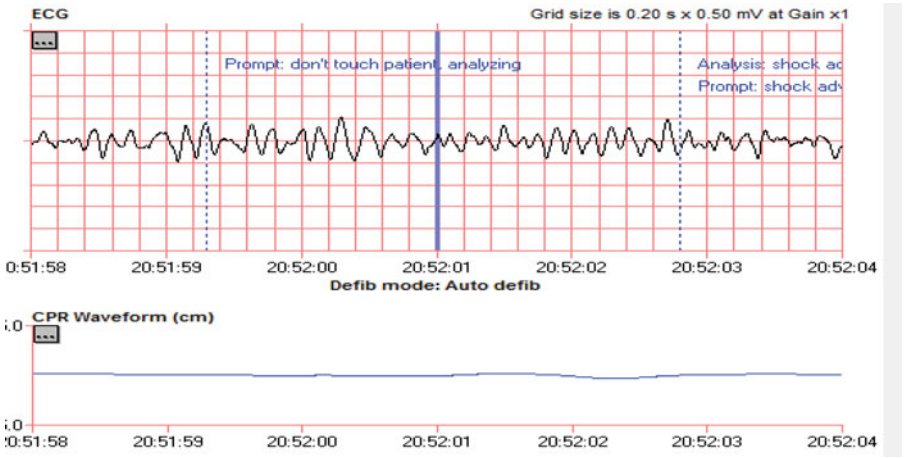

Figure 1. Presenting rhythm strip.

Cardiac arrest is classically described as a state of unresponsiveness characterized by an absence of vital signs. The critical mechanism by which CPR is thought to produce its desired outcomes is through improvements in both coronary and cerebral blood flow.[3] With the performance of high quality CPR, improvements in blood flow have been noted in animal models.[4] With improved cerebral perfusion there appears to be an emerging phenomenon of patients exhibiting signs of "induced consciousness"[5] during cardiac arrest. This phenomenon has now been described in both the prehospital and in-hospital settings[6–9] with increasing frequency providing challenges to providers during resuscitation.

CPR induced consciousness is characterized by the occurrence of "waking up," talking, fighting, or even resisting resuscitative efforts while CPR is ongoing. Classically, the symptoms resolve during interruptions (i.e., pulse checks, rhythm analysis, endotracheal intubation) in CPR. Furthermore, increasing reports of patients remembering what has occurred during the resuscitation substantiate the phenomenon of CPR induced consciousness.[4] With patients regaining consciousness or becoming combative during CPR, there are several issues that impede a successful resuscitation. As a result, traditional concepts of cardiac arrest resuscitation are being challenged as we struggle with how best to manage the phenomenon of CPR induced consciousness.

While recent studies have shown that patients can and will regain consciousness with effective CPR,[5–7] there are still very few cases documented in the literature. We provide a case report of a patient who developed signs consistent with CPR induced consciousness, while being resuscitated in the prehospital environment. The signs of CPR induced consciousness are described as well as suggestions to future management of this evolving phenomenon.

Case Report

The Region of Peel, located in Ontario, Canada is comprised of 3 municipalities (Mississauga, Brampton, and Caledon) each having their own individual fire departments and dispatch centers. Peel Regional Paramedic Service (PRPS) services all 3 of these municipalities with one Central Ambulance Communication Center (CACC). PRPS responded to approximately 84,520 emergency calls in 2015. The service employs both Advanced Care Paramedics (ACP) with full ALS training and Primary Care Paramedics (PCP) who provide BLS care. The description of the capabilities of the paramedics has been described previously.[10]

On, March 16, 2016, PRPS received a 9–1–1 call for a 52-year-old male collapsed unresponsive, with snoring respirations, and possible seizure activity. The municipal fire service was dispatched by CACC 1 minute prior to EMS and arrived on scene within 2 minutes and 30 seconds of dispatch time. The responding ACP crew arrived 5 minutes after the call was received to find a male patient in cardiac arrest for whom one defibrillation had been provided by the fire services (Figure 1). CPR was ongoing upon ACP crew arrival. The patient's medical history included an acute myocardial infarction 12 years prior and hypertension though he was not compliant with anti-hypertensive medication. His wife heard him collapse upstairs, ran to meet him, and found him unconscious on the floor. She immediately called 9–1–1.

Initial assessment by the ACP crew noted that the patient had his eyes open, was moaning and yelling, moving all limbs in what appeared to be purposeful movement to stop the resuscitation efforts (push away the CPR compressor). The cardiac monitor of the EMS crew was applied and ventricular fibrillation (VF) was noted (Figure 2). Given the unusual presentation in an OHCA, the advanced care provider requested that

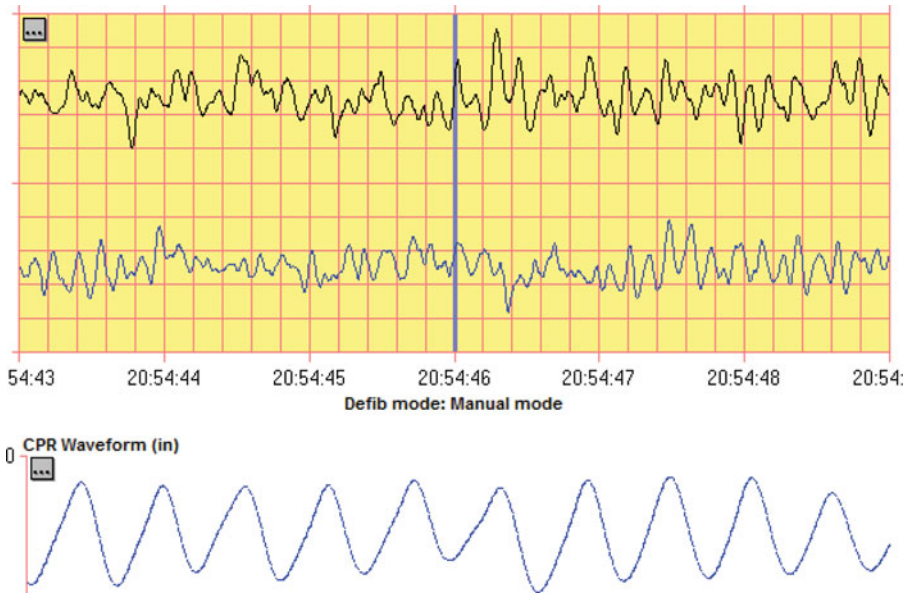

FIGURE 2. Rhythm strip during CPR induced consciousness.

CPR be paused for a short time to confirm the patient status as well as the underlying rhythm. While CPR was paused, the patient very quickly stopped making movements and noises and he became "unresponsive" once again. CPR was immediately restarted and a subsequent shock was delivered for the confirmed VF rhythm.

Over the next 6 minutes, advanced cardiac life support (ACLS) guidelines were followed including IV initiation, Epinephrine and Amiodarone administration, and CPR/defibrillation sequences. An attempt at intubation was unsuccessful due to the patient actively biting on the laryngoscope and swinging his arms toward his face during ongoing CPR.

The patient had a return of spontaneous circulation (ROSC) 11 minutes into the resuscitation, which lasted 5 minutes followed by a rearrest back into a VF rhythm. He continued to moan with eyes open and resist resuscitation efforts. After 21 minutes of resuscitation efforts, on line medical control was sought and an order for double sequential external defibrillation (DSED) was given for any subsequent shocks in efforts to terminate the refractory VF rhythm. A second ambulance was requested for a second defibrillator and after 8 shocks and 30 minutes of resuscitation a DSED was performed and ROSC was achieved.

Further resuscitation care (Table 1) included further attempts at intubation which were abandoned as the patient remained combative, biting on the laryngoscope making successful intubation impossible. While being prepared for extrication online medical control was obtained for transfer of the patient to the closest cardiac catheterization lab for emergent percutaneous coronary intervention (PCI) as ongoing ST segment elevation was noted on the patient's rhythm strip (Figure 3). Due to ongoing patient movement a 12-lead electrocardiogram (ECG) was not obtained. During extrication and transfer to the receiving PCI lab, two further re-arrests occurred between the scene and transfer of care at the emergency department of the PCI lab hospital, which was quickly terminated by defibrillation each time. Two mg of intravenous Midazolam was given following the second ROSC as the patient continued to be combative to the point where post arrest care, extrication, and transport became unsafe.

After 65 minutes of resuscitative efforts by paramedics, the patient's care was transferred to emergency room staff. A 12-lead ECG depicted an acute anterior wall ST segment myocardial infarction. The patient was transferred to the PCI lab with inotropic support including Norepinephrine. Emergency PCI was performed to find a 100% occluded left anterior descending coronary artery (LAD), which was successfully stented. The patient underwent therapeutic hypothermia and was discharged home with a Cerebral Performance Score of 1 at 72 hours after admission.

DISCUSSION

We present a case report of a 52-year-old male who sustained an OHCA successfully resuscitated by EMS followed by emergency PCI that displayed multiple clinical findings consistent with the phenomenon of CPR induced consciousness. Although the patient presented in refractory VF requiring double sequential defibrillation as well as emergent PCI for a completely obstructed LAD lesion, manifestation of CPR induced consciousness during the resuscitation provided the greatest challenge to EMS providers providing care in this case. This patient was not only combative, but exhibited signs of wakefulness during ongoing

Table 1. Sequence of actions/interventions performed during resuscitation

Time Elapsed (min)	Procedure/Event
0000	ALS patient contact
0000	Shock # 1 delivered by fire department using AED
0001	1.0 mg Epinephrine 1:10000 IV
0003	Shock # 2 at 120J
0003	300 mg Amiodarone IV
0005	Shock # 3 at 150J
0005	1.0 mg Epinephrine 1:10000 IV
0007	Shock # 4 at 200J
0007	150 mg Amiodarone IV
0009	Shock # 5 at 200J
0009	1.0 mg Epinephrine 1:10000 IV
0011	ROSC vitals HR96, RR8 Assisted, NSR, ETCO2 96mmHg, O2Sat 96%, GCS 4
0016	Rearrest
0017	Shock # 6 at 200J
0018	1.0 mg Epinephrine 1:10000 IV
0020	Shock # 7 at 200J
0021	Patch - DSED confirmed
0022	Shock # 8 at 200J
0026	ROSC vitals HR66, RR8 Assisted, NSR, ETCO2 46mmHg, O2Sat 96%, GCS 4
0028	Rearrest
0030	Shock # 9 DSED at 200J x2
0031	1.0 mg Epinephrine 1:10000 IV
0032	Analyse rhythm - PEA
0036	ROSC
0037	Patch to cardiac interventionalist for PCI - accepted
0040	Vitals - HR110, RR8 Assisted, 160/112, ETcO2 56 mmHg, GCS 7
0046	Rearrest
0046	Shock # 10 at 200J
0049	Shock # 11 at 200J
0052	1.0 mg Epinephrine 1:10000 IV
0056	1.0 mg Epinephrine 1:10000 IV
0101	ROSC
0101	Vitals HR84, RR8 Assisted, 132/56, ETcO2 91 mmHg, GCS 3
0104	Rearrest
0104	Shock # 12 at 200J
0106	ROSC and Transfer of care

ALS: *Advanced Life Support*; AED: *Automated External Defibrillator*; ETCO2; *End Tidal Carbon Dioxide Monitor*; ROSC: *Return of Spontaneous Circulation*; HR: *Heart Rate*; RR: *Respiratory Rate*; NSR: *Normal Sinus Rhythm*; GCS: *Glasgow Coma Score*; DSED: *Double Sequential External Defibrillation*.

chest compressions including making active and violent attempts to interfere with or stop the provision of CPR. There has been a minimal amount in the way of either documentation or guidelines with respect to the management of CPR induced consciousness. Although this patient had a positive outcome (discharge alive with no neurologic sequelae three days post-event), a minimal amount is known of the impact of CPR induced consciousness on one's memory of the event down the road. Clearly algorithms that allow for safe and effective management of CPR induced consciousness that minimizes resuscitation trauma as well as post-event sequelae are necessary.

Several isolated case reports have been described in the literature[5–9] with striking similarities to the case presented. All patients appear to be aware to some degree of the resuscitation as noted by their verbal and physical actions though the degree of awareness remains unknown. It is interesting to note that this phenomenon has been described irrespective of the method of CPR (manual or mechanical).[6] In this case, it was evident from CPR quality data collected (Table 2) that high quality effective CPR, consistent with resuscitation guidelines,[1–2] was able to be obtained during difficult conditions. The effect of this quality of CPR was likely an improvement in cerebral blood flow to propagate the signs of consciousness noted. While CPR was actively being performed, the patient had clear "signs of life" as indicated by moaning and yelling, making what appeared to be purposeful movement to stop the compressor from performing chest compressions, kicking his legs at providers attempting to hold him down in order to facilitate the resuscitation. These efforts made by the "vital signs absent" patient in fact complicated the resuscitation management.

Management goals of CPR induced consciousness should focus on patient safety to both improve the resuscitation process and minimize patient and provider harm. Minimizing long term psychological sequela of this condition should as well be a focus in the treatment paradigm. Current management protocols involving physical restraint of patients exhibiting this phenomenon would seem to increase the likelihood of both physical injury and psychological injury to this subset of patients. Chemical sedation would appear to hold the most promise for management of CPR induced consciousness and is now being implemented in multiple sites[7,11] although there is minimal scientific evidence to support these protocols. Clearly a balance needs to be struck between the sedative characteristics of the agents administered and their hemodynamic properties, particularly in the setting of a low flow state such as cardiac arrest. Multiple agents such as propofol, midazolam, etomidate, and ketamine have been proposed as ideal agents for the management of CPR induced consciousness but a lack of high quality evidence exists to support any particular agent. In our case, online medical control chose to use midazolam although it should be noted that this is the only sedative agent available to our paramedics. Ketamine, a dissociative anaesthesia agent would seem to be an ideal agent given its hemodynamic properties but has side effects (emergence reactions, hallucinations) that need to be considered when used for this indication. A variety of doses have been suggested (0.5–1.0 mg/kg IV, 1–2 mg/kg IM) but no scientific evidence exists to support these dosing regimens,[7] Clearly, further study would be required before supporting any single agent to manage CPR induced consciousness.

Despite the increased knowledge of the phenomenon of CPR induced consciousness, a minimal amount is known of the true frequency of this condition. Improved documentation by both EMS and in-hospital

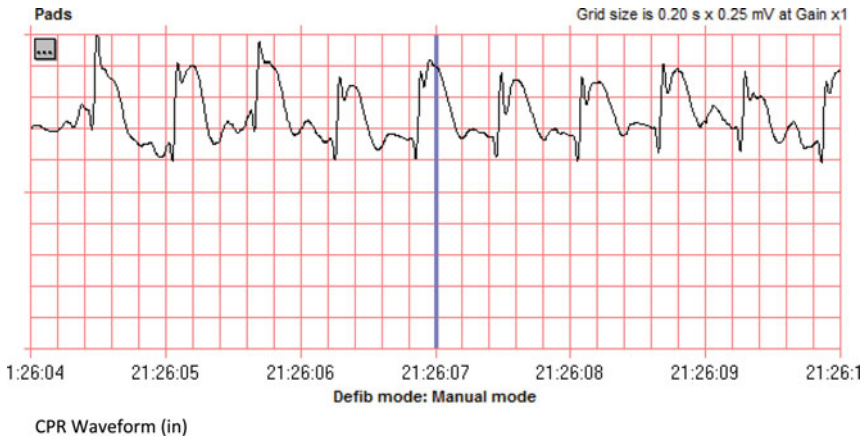

FIGURE 3. Rhythm strip prior transport to cardiac catheterization lab.

TABLE 2. CPR Process measures and treatment intervals

Measure	**Value**	AHA Target 2015
Average Compression Rate	95.42	100–120 bpm
Average Compression Depth	5.58	5.0 cm
CPR Fraction	0.82	> 0.80
Average pre-shock pause	4.0	< 10 sec
Compressions During Charging	Yes	Yes
Time to 1st Epi Admin	1 Min 0 sec	< 10 min

CPR: *Cardiopulmonary Resuscitation*; Epi: *Epinephrine*.

providers would at least provide some crude estimate of the incidence of this condition. High quality CPR as measured in this case with improved cerebral perfusion appears to be a plausible physiological explanation for our findings; however, a lack of CPR quality data collection in other case reports exists that substantiate this explanation. Linking time matched CPR quality data to clinical symptoms noted in resuscitative efforts would provide an excellent underpinning for our understanding of this phenomenon. While our case took place in a patient receiving CPR and multiple shocks for VF, it may be plausible that similar findings could occur in patients in other rhythms such as pulseless electrical activity. Determining whether changes in certain physiological parameters (i.e., increases in end tidal CO2) may herald the onset of CPR induced consciousness and warrants further consideration. Finally, although Ketamine appears to be an attractive treatment option for safe management of this condition, further study regarding the appropriate drug, dose, route (intravenous vs. intramuscular vs. infusion), and timing of administration is required such that CPR induced consciousness can be safely managed during resuscitation of cardiac arrest.

CONCLUSION

CPR induced consciousness is emerging as a new phenomenon challenging providers of high quality CPR during cardiac arrest resuscitation. Our case report describes the manifestations of CPR induced consciousness as well as the resuscitative challenges that occur during resuscitation. Further research is required to determine the true frequency of this condition as well as treatment algorithms that would allow for appropriate and safe management for both the patient and EMS providers.

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