Case report

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CPR induced consciousness: sedation protocols for this special population

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Abstract

As a result of some pre-hospital systems delivering improved neurologically intact post-cardiac arrest outcomes, there is a growing concern for the number of cases of CPR induced consciousness while the patient is otherwise pulseless and believed to be near death. This has led to the need for improved guidelines and resuscitation team training in management techniques, including the use of sedation, to safely and effectively manage patients with this condition.

This article discusses a case report of a patient who experienced an out-of-hospital cardiac arrest and regained consciousness during CPR. During his arrest medical intervention included multiple attempts at defibrillation. The patient became acutely aware of his surroundings and was able to communicate with the resuscitation team during CPR before being sedated with ketamine, taken to the catheterisation lab, successfully treated and discharged.

The case report highlights the new understanding that chest compression is a painful procedure that patients experience. There are moral and ethical considerations which must be taken into account when providing management that is painful to a patient. A sample pre-hospital guideline is proposed that incorporates the use of ketamine with or without midazolam for CPR induced consciousness.

Keywords

consciousness; CPR; sedation

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Introduction

At the moment of cessation of an effective heartbeat, cardiac arrest begins, blood pressure drops, and cerebral blood flow stops. This leads to cessation of measurable electrical brain activity in less than 30 seconds (Parnia, 2014; Parnia & Fenwick, 2002). This lack of perfusion leads to the loss of electrical activity in the brain, which is evidenced by a loss of consciousness. Following a return of spontaneous circulation (ROSC), the brain's electrical activity may be erratic for a number of minutes or hours due to continued physiological and systemic responses.

Many post resuscitation patients require complicated clinical management due to organ damage or failure, may require inotropic agents for cardiogenic shock, or may require sedation or paralytics to continue life supporting procedures. Although anoxia time, duration of CPR, quality of compressions, and cause of cardiac arrest are related to poor outcomes after CPR, they cannot be used to predict outcomes. This is in contrast to comatose post-cardiac arrest patients with myoclonus status epilepticus which correlates with a poor prognosis (Wijdicks, Hijdra, Young, Bassetti, & Wiebe, 2006).

As a result of recent advances in resuscitation science and technology such as continuous chest compressions, use of mechanical CPR devices, and other efforts to improve cerebral perfusion, some pre-hospital systems are reporting improvements in their post-arrest patient outcomes (Abella et al., 2007; Edelson et al., 2008; Kern, Hilwig, Berg, Sanders, & Ewy, 2002; Kleinman et al., 2015). One United States metropolitan paramedic service studying post-arrest hypothermia treatment excluded 21 patients from the study protocol for 'responding to commands', which equalled 10% of patients with ROSC (Kim et al., 2007).

A growing body of evidence has identified some patients receiving CPR as regaining consciousness while not having a spontaneous heartbeat. A patient making purposeful movements, even being awake and alert while in cardiac arrest, can have profound emotional and psychological implications on the patient, as well as the paramedic providers caring for them (Olaussen et al., 2015).

As a result of evidence based resuscitation techniques, an unintended consequence may be that cardiac arrest patients are 'aware' and subject to psychological trauma, in addition to the physical pain of CPR, with increasing frequency. Of additional concern is the physiological response to these factors and their impact on critically ill patients in the pre-, peri-, and post-arrest phases (Goldhill, White, & Sumner, 1999).

Contrary to the evidence, many in the medical community believe a patient in cardiac arrest is not capable of feeling pain nor able to later remember events surrounding their resuscitation (Bihari & Rajajee, 2008), although studies have found 10–20% of cardiac arrest survivors report memories from the period of resuscitation (Klemenc-Ketis, Kersnik, & Grmec, 2010). A large proportion of those patients go on to experience post-resuscitation cognitive sequelae such as post-traumatic stress disorder (PTSD) and long-term memory loss (French, 2005; Parnia, Spearpoint, & Fenwick, 2007).

As more paramedic services adopt clinically proven resuscitation practices such as high quality CPR, our concern is there will be a growing number of patients who become aware of their own cardiac arrest event. This necessitates further research, education, and training of pre-hospital care providers in the management of patients experiencing CPR induced consciousness, including the appropriate use of sedation as was first called for 20 years ago (Martens & Mullie, 1995).

The problem we face with this situation is there are no large controlled trials to study whether sedation is beneficial, or which pharmacologic agents may be best suited for it. In the meantime, we are presented with management dilemmas which need to be addressed. We present a single descriptive case report followed by a discussion of the current research and pharmacology of two medications commonly used in pre-hospital care and considerations for future research. We include a proposed method for the sedation of a patient who becomes conscious during CPR, which has been adopted by the US state of Nebraska.

Case report

Advanced care paramedics responded to a 55-year-old male with a past medical history of coronary artery disease and stent placement who developed chest pain and bilateral jaw pain while performing lawn work. Since the patient was conscious during CPR and would be moved to the catheterisation lab, the ED physician decided to sedate and intubate him. On arrival, paramedics found the patient supine in moderate distress, diaphoretic with chest pain rated at 7/10. A pre-hospital 12-lead ECG showed evidence of an inferior myocardial infarction with ST elevation in leads II, III, and AVF.

The paramedics notified the cardiac catheterisation lab (approximately 20 minutes away) and initiated transport. Just prior to arrival at the hospital, the patient became unresponsive and was found to be in ventricular fibrillation. After approximately 20 seconds of compressions and a single defibrillation the patient had ROSC.

Shortly after arrival in the emergency department (ED), the ventricular fibrillation reoccurred and manual CPR was resumed. The emergency room physician noted the patient remained awake, alert, able to speak, and engaged in purposeful movements during chest compressions. The ED staff was able to communicate to the patient including warning him when they were going to defibrillate.

Since the patient was conscious during CPR and would be moved to the catheterisation lab, the ED physician sedated and intubated him. Fourteen minutes after arrival he was sedated with 2 mg/kg of ketamine for his continued consciousness and was successfully intubated. He was defibrillated multiple times over 20 minutes due to persistent ventricular fibrillation; after 23 minutes, he finally attained sustained ROSC.

The patient was transferred to the cardiac catheterisation lab where angiography revealed a 100% occlusion of the proximal right coronary artery (RCA). After a successful stent placement, the patient was transferred to the ICU where a balloon pump was placed while he remained intubated with Lidocaine, Amiodarone, and Dopamine drips in place. Over the next 48–72 hours the balloon pump was removed, he was extubated, and IV medications were discontinued.

Due to the patient being conscious during the resuscitation, he was interviewed prior to discharge. The patient was able to clearly recall all of the events in the ED up until the time of ketamine administration including his conversation with the ED staff, the experience of CPR, and the multiple defibrillation attempts. After the ketamine bolus, he then described a floating sensation in a bright white space while hearing the defibrillator charging and feeling the shock while looking into the faces of the staff. The patient had a complete recovery without any neurological deficits and was discharged home.

Discussion

In 2015, the Leona Helmsley Foundation granted the State of Nebraska EMS Program close to 6 million dollars for the mass deployment and training of the LUCAS® 2 Chest Compression System (Nebraska Department of Health and Human Services, 2015).[1] As the EMS office began training, testing, and deploying the devices to most of the ambulance services in Nebraska, anecdotal reports of patients regaining consciousness during CPR began to surface. Due to these reports, the state EMS office staff became concerned the state model protocols did not adequately address this scenario.

The case report cited above demonstrates that during high quality CPR it is possible, even likely, to obtain and maintain cerebral blood flow sufficient enough for some patients to regain consciousness during CPR (Bihari & Rajajee, 2008). One Belgian study found 32% of ventricular fibrillation patients were gasping during CPR and 55% had pupillary responses to light. The remaining 68% were in electromechanical disassociation or asystole and among those, 12% were gasping during CPR and 36% had pupillary responses to light. These totalled 466 of 2713 or 17% of pre-hospital cardiac arrests who were gasping for air while 203 (7.5%) had pupillary responses to light. Of interest, the authors found all long-term survivors had been resuscitated within 45 minutes (Van Hoeyweghen, Mullie, Bossaert, & Cerebral Resuscitation Study Group, 1989).

The Belgian study is supported by research by Breitkreutz, Walcher, and Seeger (2007) who studied the use of focused echocardiographic evaluation in resuscitation management (FEER) during pre-hospital resuscitation. Out of the 77 cases of pre-hospital CPR they evaluated, 30 (39%) cases of pulseless electrical activity were found, including pseudo-PEA in 13 (17%) that had correctable causes.

These cases provide significant cause for concern for CPR induced consciousness because ‘pseudo-PEA’, which should be considered as a severe form of cardiogenic shock with a low or very low pump function (Breitkreutz et al., 2007), is not only survivable but could also increase neurologic function through limited cerebral blood flow in patients previously considered to be dead but still receiving CPR (Marín-Caballos et al., 2005; Moppett & Hardman, 2007).

Management

The problem of patient awareness

Parnia et al. (2007) described the concept of near death experiences (NDE) in the context of cognitive function and psychological outcomes of surviving cardiac arrest. Their work brought attention to the need to study and potentially address the needs of patients who are conscious during CPR.

Parnia et al. (2014) also conducted a multi-year, multicentre prospective study of the frequency of awareness during resuscitation by interviewing cardiac arrest survivors after discharge. They found 55/140 (39%) had awareness of being alive and even memories that originated during resuscitations.

Parnia then conducted secondary interviews and found at least 2% of survivors were accurately aware of their surroundings during CPR and concluded that the range of awareness coupled with fearful experiences might contribute to PTSD and other cognitive deficits post cardiac arrest.

Olaussen et al. (2015) conducted a systematic literature review of patients who were conscious during cardiopulmonary resuscitation, identifying 50 abstracts describing CPR induced consciousness. These 50 abstracts described 10 patients who were found to be conscious during CPR. More than half (6/10) of the cases involved mechanical CPR devices. In two cases, they found that mean arterial pressure (MAP) exceeding 50 mmHg was sufficient to awaken patients. Three of the 10 patients were sedated, three more did not mention sedation, one patient was physically restrained, and another reported they did not manage consciousness. In the last case, the providers simply asked the patient to let go of the endotracheal tube (essentially no management). This study substantially demonstrated the need for sedation management guidelines for cardiac arrest patients (Olaussen et al., 2015).

Greb (2014) published a case report during mechanical CPR and described attributes of high quality CPR. The patient was so alert he could answer questions as long as the LUCAS® device was providing compressions. When the device was briefly paused, the patient lost consciousness.

Gamper et al. (2004) noted that the occurrence of PTSD was no different for patients with or without sedation during and after cardiac arrest. Several authors indicate that outcome predictions are confounded in post cardiac arrest patients who have been sedated (Samaniego, Mlynash, Caulfield, Eyngorn, &Wijman, 2011).

As a result of these studies, pundits might suggest that sedation of a cardiac arrest patient is unnecessary as it does not reduce PTSD and may confound post arrest monitoring (Wijdicks et al., 2006). This position overlooks the immediate benefit to the patient by delivering sedation and analgesia.

Wacht, Huri, & Strugo (2015) published a case report of a combative cardiac patient and focused specifically on patient management, including a synopsis of commonly used medications in the pre-hospital environment which might be beneficial for sedating patients with CPR induced consciousness. They recommended the use of fentanyl or ketamine, citing their minimal cardiovascular effects.

The only published guidelines we identified for sedation of patients who become conscious during CPR are the Dutch National Ambulance Guidelines which recommend the use of fentanyl and midazolam to treat 'pain with mechanical chest compressions' (Landelijk Protocol Ambulancezorg, 2014).

Although not conclusively quantified, the presence of increasing numbers of reports in literature may indicate that the rate of patients experiencing CPR induced consciousness within the general population is increasing as more paramedic services adopt better CPR techniques. The Dutch recognise that CPR is painful and approach the patient in this manner. How should paramedic providers handle CPR induced consciousness?

Treatment: saving the brain while easing the pain

Deciding which medications can be safely used to sedate a patient undergoing CPR extends beyond basic pharmacology. It must take into account which medications are readily available in the pre-hospital environment, including potential shortages and cost. Medications for procedural sedation and analgesia are numerous; however, considering a medication that fits our patient population narrows the possibilities considerably.

A patient who becomes conscious during CPR will need both sedation and analgesia. Furthermore, in choosing sedatives, analgesics, and a paralytic if needed, we believe medications that support myocardial and cerebral blood flow should be favoured over drugs which might have the typical concerns about airway management or respiratory depression. Other desirable traits should also include a rapid onset of action, ease of storage and administration, reasonable cost, and familiarity to pre-hospital providers. Considering these traits, two medications which are more commonly found in advanced life support services in the United States were identified: ketamine and midazolam.

Ketamine

Ketamine is a sedative hypnotic that produces a rapid anaesthetic state with associated analgesic properties. Ketamine is desirable in the pre-hospital environment because it allows patients to maintain their own pharyngeal reflexes even when fully dissociated (Strayer & Nelson, 2008). Ketamine also provides normal or slightly enhanced muscle tone, cardiovascular and respiratory stimulation, and transient dose-dependent respiratory depression. These properties make ketamine preferential for both sedation and analgesia (Gold Standard, Inc., n.d.a; McGhee, Maani, Garza, Gaylord, & Black, 2008). When administered IV, the sensation of dissociation occurs in as little as 15 seconds followed by anaesthesia occurring within 30 seconds. Ketamine has a half-life of 10–15 minutes which corresponds clinically to the anaesthetic effect of the medication. Since paramedic providers are busy during a CPR event, the fast acting nature of ketamine makes it a convenient choice for use in CPR induced consciousness.

Despite concerns for pre-hospital use, ketamine has an excellent safety profile and has been described as being safe for use in austere environments in which there is minimal monitoring available (Reuben, Strayer, Lewis, & Nelson, 2008). Advanced care paramedic providers use this medication regularly given its safety and familiarity. The rare event of respiratory depression should not be a concern where airway management during CPR is already being addressed.

There is some debate on ketamine's effects on the cardiovascular system. The mechanism by which ketamine causes a sympathetic surge to stimulate the cardiovascular system has yet to be elucidated. The use of concurrent benzodiazepines or the administration of ketamine as a continuous infusion may reduce these cardiovascular effects (Miller, 2010). We acknowledge that Miller's considerations for cardiac preservation do not include the condition of cardiac arrest.

Because ketamine may increase myocardial oxygen consumption due to increased cardiac activity, some providers may be hesitant to use ketamine on patients with cardiac disease. Though ketamine does increase heart rate, blood pressure, and cardiac output, this may be a moot point or even advantageous in a patient with cardiac arrest. It is not clear whether the theoretical increase in myocardial oxygen demand even exists in a cardiac arrest situation.

A known side effect famous to ketamine is the 'emergence reaction'. We considered whether this side effect would cause an increase in cerebral oxygen demand and potentially worsen neurologic outcome. There is great debate occurring among some researchers about the metabolic requirements of cognitive processes during NDE. One significant impediment to conclusive determination is the fact that memories expressed post-resuscitation are actually reports of experiences, rather than measurements of the experiences themselves. Therefore, due to the lack of incontrovertible evidence to the contrary, ethical medical decision making must first consider the probability that a significant proportion of patients will report experiences of pain or NDE, and that some will recount portions of the resuscitation procedure when conventional wisdom would otherwise consider them dead (French, 2005). Since there is a concern about cerebral activity and cerebral oxygen demand, we considered the possibility of using a second medication along with ketamine.

Midazolam

Midazolam hydrochloride is a benzodiazepine class medication used for several indications in the hospital including the induction of general anaesthesia, maintenance of anaesthesia, pre-operative sedation, anxiolysis, and amnesia. Onset of action is 2–5 minutes IV with a peak effect of 6–10 minutes. Midazolam also has widespread use in the pre-hospital environment with similar indications for use including sedation, anxiolysis, amnesia, and seizure termination. As compared to ketamine, midazolam has a negative cardiovascular and haemodynamic profile with noted lower cardiac output and depressive cardiovascular effects (Gold Standard, Inc., n.d.b). Midazolam does not offer any analgesic effects compared to ketamine, therefore it is inappropriate as a first line agent or for mono therapy.

Given the intended goal of both amnesia and analgesia in patients with CPR induced consciousness, we believe ketamine to be the optimal choice. Co-administration of midazolam with ketamine should theoretically offer the benefit of preventing increases in myocardial oxygen demand while simultaneously reducing the risk of the emergence reaction from ketamine.

Proposed model protocols

The State of Nebraska EMS Program provides model state guidelines for the care of pre-hospital patients (Table 1; Nebraska Department of Health and Human Services, 2012). Although paramedic services are allowed to locally create their own treatment guidelines, Nebraska state law provides statutory protection from civil litigation for using model state guidelines. The proposed model guideline is excerpted from the Nebraska Model Protocol and stratifies the care to be given by primary care paramedics (EMTs), intermediate care paramedics (advanced EMTs), and advanced care paramedics (paramedics).

Table 1. CPR induced consciousness sedation guideline.

Advanced care paramedics*
Assess for signs of consciousness:
Spontaneous eye opening, purposeful movement, verbal response including moaning
- Administer ketamine bolus
  IV: 0.5–1.0 mg/kg
  IM: 2–3 mg/kg
- Consider co-administration of midazolam bolus
  IV: 1 mg
  IV: 1 mg
- May repeat ketamine bolus after 5–10 minutes if needed for continued sedation or for continued sedation
- Start infusion
  IV bolus dose: 0.5–1.0 mg/kg OR IM: 2–3 mg/kg
  IV infusion dose: 2–7 microgram/kg/minute

*Training classification has been adapted to international classification standards

Conclusion

CPR induced consciousness is becoming more frequent due to high quality CPR that results from improved training with a focus on cerebral resuscitation and the use of mechanical CPR devices. Healthcare providers must retrain themselves to think of cardiac arrest patients as people who may be experiencing pain during resuscitation.

Due to a paucity of research and literature covering this once unusual situation, there is need for further evaluation of medications used for sedation in cardiac arrest. Pharmacological effects of myocardial oxygen demand should be further explored, in addition to cortical function and neurological outcomes following resuscitation.

Our proposed model guideline balances the ethical concerns for sedation and analgesia during a painful and traumatic procedure despite a condition specific lack of evidence. EMS physicians and paramedic providers should encourage collegial debate and study as this situation becomes more commonplace.

Conflict of interest

None declared.

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None.

Note

1. LUCAS® 2 Chest Compression System is a Registered Trademark of Jolife AB/Physio Control. None of the authors were involved in the production of, and do not endorse, this product.

References

Abella, B. S., Edelson, D. P., Kim, S., Retzer, E., Myklebust, H., Barry, A. M., & Becker, L. B. (2007). CPR quality improvement during in-hospital cardiac arrest using a real-time audiovisual feedback system. *Resuscitation, 73*(1), 54–61.

Bihari, S., & Rajajee, V. (2008). Prolonged retention of awareness during cardiopulmonary resuscitation for asystolic cardiac arrest. *Neurocritical Care, 9*(3), 382–386.

Breitkreutz, R., Walcher, F., & Seeger, F. H. (2007). Focused echocardiographic evaluation in resuscitation management: Concept of an advanced life support-conformed algorithm. *Critical Care Medicine, 35*(5), S150–S161.

Edelson, D. P., Litzinger, B., Arora, V., Walsh, D., Kim, S., Lauderdale, D. S., & Abella, B. S. (2008). Improving in-hospital cardiac arrest process and outcomes with performance debriefing. *Archives of Internal Medicine, 168*(10), 1063–1069.

French, C. C. (2005). Near-death experiences in cardiac arrest survivors. *Progress in Brain Research, 150*, 351–367.

Gamper, G., Willeit, M., Sterz, F., Herkner, H., Zoufaly, A., Hornik, K., …, & Laggner, A. N. (2004). Life after death: Posttraumatic stress disorder in survivors of cardiac arrest – Prevalence, associated factors, and the influence of sedation and analgesia. *Critical Care Medicine, 32*(2), 378–383.

Gold Standard, Inc. (n.d.a). Ketamine. Clinical pharmacology [database online]. Retrieved from: http://www.clinicalpharmacology.com (accessed 22 October 2015).

Gold Standard, Inc. (n.d.b). Midazolam. Clinical pharmacology [database online]. Retrieved from: http://www.clinicalpharmacology.com (accessed 22 October 2015).

Goldhill, D. R., White, S. A., & Sumner, A. (1999). Physiological values and procedures in the 24 h before ICU admission from the ward. *Anaesthesia, 54*(6), 529–534.

Greb, C. (2014, 29 January). Mechanical CPR helps save the day—and the patient. *JEMS*. Retrieved from: http://www.jems.com/articles/print/volume-39/issue-2/departments-columns/case-of-the-month/mechanical-cpr-helps-save-day-and-patien.html.

Kern, K. B., Hilwig, R. W., Berg, R. A., Sanders, A. B., & Ewy, G. A. (2002). Importance of continuous chest compressions during cardiopulmonary resuscitation improved outcome during a simulated single lay-rescuer scenario. *Circulation, 105*(5), 645–649.

Kim, F., Olsufka, M., Longstreth, W. T., Maynard, C., Carlbom, D., Deem, S., …, & Cobb, L. A. (2007). Pilot randomized clinical trial of prehospital induction of mild hypothermia in out-of-hospital cardiac arrest patients with a rapid infusion of 4 C normal saline. *Circulation, 115*(24), 3064–3070.

Kleinman M. E., Brennan, E. E., Goldberger, Z. D., Swor, R. A., Terry, M., Bobrow, B. J., …, Rea, T. (2015). Part 5: Adult basic life support and cardiopulmonary resuscitation quality: 2015 American Heart Association guidelines update for cardiopulmonary resuscitation and emergency cardiovascular care. *Circulation, 132*(suppl 2), S414–S435.

Klemenc-Ketis, Z., Kersnik, J., & Grmec, S. (2010). The effect of carbon dioxide on near-death experiences in out-of-hospital cardiac arrest survivors: A prospective observational study. *Critical Care, 14*(2), R56.

Landelijk Protocol Ambulancezorg. (2014). Int'l Veld Dutch National Guidelines (translated). 8, 5.2, 38.

Marín-Caballos, A. J., Murillo-Cabezas, F., Cayuela-Domínguez, A., Domínguez-Roldán, J. M., Rincón-Ferrari, M. D., Valencia-Anguita, J., …, & Muñoz-Sánchez, M. A. (2005). Cerebral perfusion pressure and risk of brain hypoxia in severe head injury: A prospective observational study. *Critical Care, 9*(6), 670–676.

Martens, P., & Mullie, A. (1995). Sedation during and after CPR-efforts: Is it worth a guideline? *Resuscitation, 29*(3), 223–224.

McGhee, L. L., Maani, C. V., Garza, T. H., Gaylord, K. M., & Black, I. H. (2008). The correlation between ketamine and posttraumatic stress disorder in burned service members. *Journal of Trauma and Acute Care Surgery, 64*(2), S195–S199.

Miller, R. D. (2010). *Miller's Anesthesia* (7th ed.). Philadelphia PA: Churchill Livingstone.

Moppett, I. K., & Hardman, J. G. (2007). Modeling the causes of variation in brain tissue oxygenation. *Anesthesia & Analgesia, 105*(4), 1104–1112.

Nebraska Department of Health and Human Services. (2012). Nebraska Board of EMS: Approved EMS model protocols. Retrieved from: http://dhhs.ne.gov/publichealth/Licensure/Documents/EMSmodelProtocols2012.pdf.

Nebraska Department of Health and Human Services. (2015, 15 April). Lt. Governor Foley announces $6 million grant to help save the lives of Nebraskans. Retrieved from: http://dhhs.ne.gov/Pages/newsroom_newsreleases_2015_april_grant.aspx.

Olaussen, A., Shepherd, M., Nehme, Z., Smith, K., Bernard, S., & Mitra, B. (2015). Return of consciousness during ongoing cardiopulmonary resuscitation: A systematic review. *Resuscitation, 86*, 44–48.

Parnia, S. (2014). Death and consciousness – An overview of the mental and cognitive experience of death. *Annals of the New York Academy of Sciences, 1330*(1), 75–93.

Parnia, S., & Fenwick, P. (2002). Near death experiences in cardiac arrest: Visions of a dying brain or visions of a new science of consciousness. *Resuscitation, 52*(1), 5–11.

Parnia, S., Spearpoint, K., de Vos, G., Fenwick, P., Goldberg, D., Yang, J., … & Wood, M. (2014). AWARE – AWAreness during REsuscitation – A prospective study. *Resuscitation, 85*(12), 1799–1805.

Parnia, S., Spearpoint, K., & Fenwick, P. B. (2007). Near death experiences, cognitive function and psychological outcomes of surviving cardiac arrest. *Resuscitation, 74*(2), 215–221.

Reuben, J., Strayer, M. D., Lewis, S., & Nelson, M. D. (2008). Adverse events associated with ketamine for procedural sedation in adults. *American Journal of Emergency Medicine, 26*, 985–1028.

Samaniego, E. A., Mlynash, M., Caulfield, A. F., Eyngorn, I., & Wijman, C.A. (2011). Sedation confounds outcome prediction in cardiac arrest survivors treated with hypothermia. *Neurocritical Care, 15*(1), 113–119.

Strayer, R. J., & Nelson, L. S. (2008). Adverse events associated with ketamine for procedural sedation in adults. *American Journal of Emergency Medicine, 26*, 985–1028.

Van Hoeyweghen, R., Mullie, A., Bossaert, L., & Cerebral Resuscitation Study Group. (1989). Decision making to cease or to continue cardiopulmonary resuscitation (CPR). *Resuscitation, 17*, S137–S147.

Wacht, O., Huri, R., Strugo, R. (2015). Combative cardiac patients: What to do when a patient regains consciousness during mechanical CPR. *EMS World, 44*(8), 29–33. Retrieved from: www.emsworld.com/article/12087677/case-study-combative-cardiac-patient.

Wijdicks, E. F., Hijdra, A., Young, G. B., Bassetti, C. L., & Wiebe, S. (2006). Practice parameter: Prediction of outcome in comatose survivors after cardiopulmonary resuscitation (an evidence-based review). Report of the Quality Standards Subcommittee of the American Academy of Neurology. *Neurology, 67*(2), 203–210.