



Clinical Paper

Outcomes of patients resuscitated from cardiac arrest in the setting of drug overdose



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ABSTRACT

Objectives: To compare the attributes and clinical outcomes of patients with cardiac arrest in the setting of drug overdose (OD) to patients with cardiac arrest from non-drug related etiologies.

Methods: We utilized a US inpatient cardiac arrest registry used to study targeted temperature management (TTM) to identify patients with cardiac arrest in the setting of drug overdose between 2005 and 2013. Data regarding the cardiac arrest, resuscitation interventions, use of post-arrest TTM, urine drug screen, survival, and neurologic outcome were examined. These results were compared to patients suffering cardiac arrest from other causes during the same time period using Wilcoxon rank-sum tests for continuous variables and chi-square tests on categorical variables.

Results: Approximately 2.5% (64/2584) of cardiac arrests occurred in the setting of drug overdose. Patients in the OD cohort were younger, more likely to be male, and more likely to have an out-of-hospital cardiac arrest that was unwitnessed with no bystander CPR and from a non-shockable rhythm. However, the patients in the OD cohort had similar rates of survival and good neurologic outcomes (Cerebral Performance Category 1–2) compared to non-OD patients. A fraction of initially resuscitated patients in each group (8% in OD cohort vs. 15% in non-OD cohort, $p = ns$) did not receive post-arrest TTM due to prompt awakening following resuscitation.

Conclusions: Patients resuscitated from cardiac arrest in the setting of drug OD have neurologic and survival outcomes comparable to non-OD patients despite lower rates of bystander CPR, shockable rhythms, and witnessed arrest.

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1. Introduction

There are approximately 424,000 EMS-assessed out of hospital cardiac arrests each year in the United States, with approximately 60% of these treated by EMS personnel.¹ During cardiopulmonary resuscitation (CPR) one of the core tasks is to identify and treat reversible causes of arrest including drug overdose. Adverse cardiovascular events have been reported to occur in up to 9.3% of all drug overdoses and in up to 16.9% of hospital admissions for drug overdose.² Recently, prescription drug overdose (OD) has become the leading cause of accidental death in the United States.³ In 2011, approximately 110 Americans died from drug OD each day, and prescription opioid analgesics accounted for over 16,900 (42%) of these deaths, representing more than a three-fold increase since

1999.⁴ Heroin was responsible for an additional 4300 deaths in 2011 as well.⁵ In addition to the morbidity and mortality associated with prescription drug OD, they also constitute an enormous public health and financial burden on the healthcare system. Almost 500,000 emergency department visits in 2009 were due to the misuse or abuse of prescription opioid analgesics.⁴ Other illicit drugs including cocaine, heroin, amphetamines, and marijuana also continue to be commonly abused, and in 2012, 9.2% of all Americans over the age of 11 used an illicit drug in the prior month compared to 8.3% in 2002.⁶ This is a concerning trend that may further increase the incidence of lethal drug overdose.

Although fatal drug OD have increased in the past decade, little is known about the outcomes of patients resuscitated from cardiac arrest in the setting of drug OD and how these outcomes compare to the outcomes of patients resuscitated from cardiac arrest secondary to other etiologies. There is a continuum of outcomes after cardiac arrest, beginning with return of spontaneous circulation (ROSC), followed by admission to the hospital, and subsequently including survival to hospital discharge and neurologic outcome at discharge.

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There is little data about what percentage of cardiac arrests caused by drug overdoses have ROSC, are admitted to the hospital, survive to hospital discharge, or have a favorable neurological outcome at the time of discharge.

Post-arrest targeted temperature management (TTM) is implemented in patients who remain comatose after ROSC to treat post-arrest anoxic encephalopathy and to optimize neurological outcomes. TTM has been demonstrated to improve both survival and neurological outcomes after cardiac arrest.^{7–9} While TTM has been in increasingly widespread clinical use over the past decade, the three major randomized studies focused on patients with arrests secondary to primary cardiac etiologies.^{7,8,10} This study examined characteristics of patients with cardiac arrest in the setting of drug overdose with the objective of comparing the attributes and outcomes of patients with cardiac arrest in the setting of drug OD to patients with cardiac arrest from non-OD causes.

2. Methods

This study was approved by the Institutional Review Board of the University of Pennsylvania. This is a retrospective study using a US cardiac arrest registry, the Penn Alliance for Therapeutic Hypothermia (PATH), to identify patients with cardiac arrest between 2005 and 2013. This database includes twenty-eight member hospitals around the country, all of which contributed to the database, and was established to enable both quality assurance and research efforts surrounding post-arrest care. All patients presenting to participating hospitals with both out-of-hospital and in-hospital cardiac arrests as defined by loss of pulse requiring chest compressions are eligible for entry into the PATH database. A patient does not have to receive TTM to be entered into the database. Case entry is performed by a healthcare provider trained by the PATH database manager, and data integrity is ensured by a formal auditing process with feedback provided for correction.

For our analysis, the PATH database was queried to identify all patients with cardiac arrest in the setting of drug OD. Attribution of drug OD as a suspected etiology for the cardiac arrest is designated by the provider involved in the patient's care and extracted by the provider entering patients into the database. Data entry personnel at participant hospitals when entering "no" for the question of whether an arrest was cardiac in etiology are prompted to select an alternative etiology of arrest, of which "drug overdose" is an option. In some cases, Emergency Medical Services (EMS) reports and/or urine drug screen data were available to help confirm an OD, but in other cases the determination of arrest etiology was based solely on the information and history available to the clinicians involved as extracted by data entry personnel. For the OD patients who did not achieve ROSC, urine drug screen (UDS) data were not available. The cohort of patients who had a suspected drug overdose as the etiology of arrest was compared to that of patients whose cardiac arrest was deemed secondary to another cause.

Demographic data including patient's age and gender, as well as pre-, intra-, and post-arrest data for OD patients were analyzed and compared to the non-OD cardiac arrest patients during the same period. Outcome measures were survival and neurologic outcome after discharge which was categorized by the Cerebral Performance Category (CPC) score. CPC outcomes involve a scale that ranges from 1 to 5, representing worsening neurological deficits; in previous studies a favorable neurologic outcome has been defined as a CPC score of 1 or 2, and a poor neurologic outcome as a CPC score of 3, 4, or 5. Data analysis was performed using Wilcoxon rank-sum tests for non-parametric continuous variables and chi-square tests for categorical variables. Data were analyzed using Stata 13.0 (StataCorp, College Station, TX). Significant *p* values were defined as *p* < 0.05.

Table 1

Cumulative data comparing demographic characteristics, characteristics about the arrests, and outcomes between cardiac arrests attributed to drug OD and cardiac arrests attributed to all other causes.

	OD (n = 64)	Non-OD (n = 2520)	<i>p</i>
Age (median, IQR)	40 (28, 52)	66 (54, 78)	<0.001
Male	46 (72)	1444 (57)	0.02
Location: out of hospital	58 (91)	1737 (69)	<0.001
Witnessed	20 (32)	1727 (72)	<0.001
Shockable	5 (8)	592 (25)	0.003
Bystander CPR performed	9 (16)	629 (34)	0.004
Duration (min)	28.5 (18, 49)	16 (8, 30)	0.0017
ROSC	25 (39)	1173 (47)	ns
TTM (of those with ROSC)	16 (64)	576 (49)	ns
Excluded from TTM due to prompt awakening	2 (8)	177 (15)	ns
Survival	10 (16)	469 (19)	ns
Cerebral Performance Category CPC 1–2 at discharge	8 (13)	409 (16)	ns

3. Results

A small percentage (64/2584 = 2.5%) of the cardiac arrests from the PATH database were in the setting of overdose. When comparing the OD cohort and the non-OD cohort, the two groups differed in median age, sex, location of arrest, percentage with witnessed arrests, initial shockable rhythms, rate of bystander CPR, and duration of arrest (Table 1). Despite the fact that the OD cohort had lower rates of in-hospital arrests, witnessed arrests, shockable rhythms, and bystander CPR, these patients had similar rates of survival and good neurologic outcomes when compared to the non-OD cohort. These similar outcomes included rate of ROSC (39% vs. 47%, *p* = ns), rate of survival (16% vs. 19%, *p* = ns), and rate of recovery with CPC 1–2 (13% vs. 16%, *p* = ns). A fraction of patients in each group (OD: 2/25, 8%; non-OD: 177/1173, 15%; *p* = ns) did not receive TTM due to prompt awakening post-arrest. Due to the small number of patients that received TTM in the OD cohort (*n* = 16), we were underpowered to further analyze the effects of TTM in this group (Table 2).

In order to further explore the nature of the patients who were classified as deaths in the setting of an OD, urine drug screen data were analyzed. Of the patients who achieved ROSC, 16/25 had a documented UDS. 15/16 (94%) were positive, with 11 (69%) containing opioids and 8 (50%) containing cocaine, with overlap between the two groups. Overall, 14/16 (88%) urine drug screens contained at least one opioid, benzodiazepine, or cocaine (Fig. 1). The other two OD cardiac arrests were in the setting of other ingestions, not clearly picked up on the UDS.

4. Discussion

In this investigation we found that patients with cardiac arrest in the setting of drug OD had similar outcomes when compared to patients with cardiac arrest from non-drug OD etiologies. When comparing the OD cardiac arrest cohort to the non-OD cardiac

Table 2

This table demonstrates the breakdown of survivors vs. non-survivors of (a) OD-induced and (b) non-OD-induced cardiac arrest patients who received TTM.

Outcome	OD patients		Non-OD patients	
	<i>n</i>	Percent of total (%)	<i>n</i>	Percent of total (%)
<i>Outcomes of patients receiving TTM</i>				
Non-survivors	11	69	341	59
Survivors	5	31	235	41
CPC 1–2	4	25	200	35
Total	16	100	576	100

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