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Clinical paper

Outcomes associated with amiodarone and lidocaine in the treatment of in-hospital pediatric cardiac arrest with pulseless ventricular tachycardia or ventricular fibrillation☆

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ABSTRACT

Aim: To determine the association between amiodarone and lidocaine and outcomes in children with cardiac arrest with pulseless ventricular tachycardia (pVT) and ventricular fibrillation (VF).
Background: Current AHA guidelines for CPR and emergency cardiovascular care recommend amiodarone for cardiac arrest in children associated with shock refractory pVT/VF, based on a single pediatric study and extrapolation from adult data.
Methods: Retrospective cohort study from the Get With the Guidelines-Resuscitation database for in-patient cardiac arrest. Patients < 18 years old with pVT/VF cardiac arrest were included. Patients receiving amiodarone or lidocaine prior to arrest or whose initial arrest rhythm was unknown were excluded. Univariate analysis was performed to assess the association between patient and event factors and clinical outcomes. Multivariate analysis was performed to address independent association between lidocaine and amiodarone use and outcomes.
Results: Of 889 patients, 171 (19%) received amiodarone, 295 (33%) received lidocaine, and 82 (10%) received both. Return of spontaneous circulation (ROSC) occurred in 484/889 (54%), 24-h survival in 342/874 (39%), and survival to hospital discharge in 194/889 (22%). Lidocaine was associated with improved ROSC (adjusted OR 2.02, 95% CI 1.36–3), and 24-h survival (adjusted OR 1.66, 95% CI 1.11–2.49), but not hospital discharge. Amiodarone use was not associated with ROSC, 24 h survival, or survival to discharge.
Conclusions: For children with in-hospital pVT/VF, lidocaine use was independently associated with improved ROSC and 24-h survival. Amiodarone use was not associated with superior rates of ROSC, survival at 24 h. Neither drug was associated with survival to hospital discharge.

1. Introduction

Cardiac arrest in the pediatric population remains a significant cause of morbidity and mortality.[1] Most pediatric in-hospital cardiac arrests present with the non-shockable rhythms of asystole or pulseless electrical activity (PEA). Nevertheless, pulseless ventricular tachycardia (pVT) and ventricular fibrillation (VF) occur in up to 27% of in-hospital events.[2,3] Although the data for pharmacologic treatment of pediatric refractory pVT/VF are limited, current American Heart Association (AHA) Guidelines for Cardiopulmonary Resuscitation (CPR) and emergency cardiovascular care (ECC) recommend the use of amiodarone as the first anti-arrhythmic medication for shock refractory pVT/VF.[4] The recommendation is

Abbreviations: AHA, American Heart Association; CPR, cardio pulmonary resuscitation; DC, discharge; ECC, emergency cardiovascular care; ECG, electrocardiogram; GWTG-R, Get With The Guidelines-Resuscitation; NRCPR, National Registry of Cardiopulmonary Resuscitation; ROSC, return of spontaneous circulation; pVT, pulseless ventricular tachycardia; VF, ventricular fibrillation.

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based on a single pediatric study[5] supporting the safety and efficacy of amiodarone in children with ventricular tachycardia without cardiac arrest and on data in adult populations of out-of-hospital cardiac arrest showing improved survival to hospital admission with the use of amiodarone as compared to lidocaine.[6–9] While data from adults is often extrapolated to the pediatric population, the comparison may not be ideal since the etiology of cardiac arrest is often different in adults. To date, there have been no pediatric studies directly assessing the effectiveness of lidocaine for ventricular arrhythmias, and no studies evaluating anti-arrhythmic medication use and hospital outcome in pediatric patients having cardiac arrest.

The aim of our study was to determine the association between amiodarone and lidocaine use and clinical outcomes in children[10] with cardiac arrest due to pVT/VF. Based on adult literature, we hypothesized that the use of amiodarone would be associated with improved survival outcomes, and that lidocaine would not be associated with improved survival outcomes. We addressed these hypotheses through analysis of in-hospital pediatric CPR events reported to the American Heart Association's multi-center Get With The Guidelines-Resuscitation (GWTG-R) registry from 2000 to 2008.

2. Methods

This was a retrospective cohort study from a multihospital database of patients receiving chest compressions and/or defibrillation for in-hospital cardiac arrest from January 2000 to February 2008. The study was approved by the Institutional Review Boards of The University of Arizona College of Medicine and The Children's Hospital of Philadelphia.

2.1. GWTG-R

The American Heart Association's Get With the Guidelines-Resuscitation registry (GWTG-R; formerly the National Registry of Cardiopulmonary Resuscitation) is a prospective, multisite, in-hospital resuscitation registry sponsored by the AHA. Hospitals join the GWTG-R registry voluntarily. At each participating institution, research coordinators abstract information about cardiac arrests from hospital medical records. The database contains precisely defined variables derived from the Utstein-style data reporting guidelines for cardiac arrest.[10,11] Data abstractors must complete a certification examination consisting of multiple-choice questions and mock scenarios covering operational definitions and criteria for inclusion and exclusion. Case study methodology is used to evaluate data abstraction, entry accuracy, and operational definition compliance before acceptance of data transmission.

The six major categories of variables are facility data, patient demographic data, pre-event data, event data, outcome data, and quality improvement data. Explicit operational definitions were generated for every data element. Cardiac arrest is defined as the cessation of cardiac mechanical activity, determined by the absence of palpable central pulse, unresponsiveness and apnea. Initial pulseless VT and VF are defined as pVT and VF that occurs as the first documented cardiac arrest rhythm. Subsequent pVT or VF is defined as pVT or VF that occurs at some time during the subsequent resuscitation but not as the first documented cardiac arrest rhythm. Subsequent pVT and VF arrests are combined as a single data element in this database because they have similar epidemiologic characteristics, behavior and treatment.

Each patient is assigned a unique code, and specific patient identifiers are not sent to the central database repository, which is in compliance with the Health Insurance Portability and Accountability Act. The data are securely transmitted to the central database repository. The AHA oversees the entire process of data collection, analysis, and reporting through its national center staff, scientific advisory board and executive database steering committee. The primary purpose of the GWTG-R is quality improvement by benchmarking against national and peer standards; participating hospitals are therefore not required to obtain approval from their institutional review boards.

2.2. Inclusion and exclusion criteria

Data were analyzed from 242 hospitals that provided data for at least 6 months during the study period from January 2000 to February 2008. All patients who were younger than 18 years and sustained a clinical event that required chest compressions for at least 2 min at a participating hospital were eligible for inclusion. According to GWTG-R operational definitions, a CPR event includes any event characterized by either pulselessness or critically compromised perfusion treated with chest compressions and/or defibrillation, when a unit-wide or hospital-wide emergency response was activated. Events that commence out-of-hospital and events in newborn infants in the delivery suite are excluded. Patients whose resuscitation response was altered as the result of an advanced directive or pre-existing "do not attempt resuscitation (DNAR)" order were excluded.

For our study, all patients meeting database operational definitions who had documented pVT/VF at some point during their event were included. Patients were excluded if they had no pVT/VF, if they were receiving lidocaine and/or amiodarone therapy prior to their event, or if their initial arrest rhythm was unknown.

For the purpose of this study, the prospectively determined primary outcome variable was return of spontaneous circulation (ROSC). Secondary outcomes included 24-h survival and survival to hospital discharge.

2.3. Descriptive and univariate analysis

A list of patient and event characteristics were defined by the investigators *a priori* for consideration as possible confounders based on significant associations with clinical outcomes in prior analyses of pediatric data from the GWTG-R registry (Table 1).[2,3,12,13] Event duration was defined as the time interval from the delivery of the first chest compression until either the time of sustained ROSC (lasting >20 min) or the time when resuscitation efforts were terminated. Respiratory support was defined as the presence of one of the following: assisted ventilation, mechanical ventilation, or inhaled nitric oxide. Cardiovascular support was defined as the presence of one of the following: any vasoactive infusion, any antiarrhythmic infusion (other than lidocaine or amiodarone), a pulmonary artery catheter, or an intra-aortic balloon pump. Monitored was defined as presence of ECG, pulse oximetry, or apnea monitor. Newborns were those patients < 1 month of age, infants were 1 month to 1 year old, children were 1–11 years old and adolescents were 12–17 years old. Univariate comparison between survivors and non-survivors for each outcome was made for each variable in the a priori set of potential confounders using Chi Square testing with a significance level of 0.05.

2.4. Multivariate analysis

All continuous variables of interest were collapsed to nominal variables by observing the results of a logistic regression for every possible binary cut point and choosing the cut point with the maximum test statistic, for each outcome. Logistic regression models were used to examine the effect of variables of interest on binary survival outcomes. For each outcome, a multivariable