Resuscitation 101 (2016) 6–11

Contents lists available at ScienceDirect

Resuscitation

journal homepage: www.elsevier.com/locate/resuscitation

Clinical paper

Life-threatening ventricular tachyarrhythmias in the cardiology department: Implications for appropriate prescription of telemetry monitoring☆

Alessandro Zorzi[a], Francesco Peruzza[a], Federica Stella[b], Alvise Del Monte[a], Federico Migliore[a], Nicola Gasparetto[a], Luigi Badano[a], Sabino Iliceto[a], Domenico Corrado[a,*]

[a] Department of Cardiac, Thoracic and Vascular Sciences, University of Padova, Padova, Italy
[b] Department of Medicine, University of Padova, Padova, Italy

ARTICLE INFO

Article history:
Received 29 July 2015
Received in revised form
15 November 2015
Accepted 25 December 2015

Keywords:
Arrhythmia
In-hospital cardiac arrest
Cardiopulmonary resuscitation
Defibrillation
Ventricular tachycardia
Ventricular fibrillation

ABSTRACT

Background: in-hospital life-threatening ventricular arrhythmias (LT-VA) may complicate the course of cardiovascular patients. We aimed to assess the incidence, circumstances, determinants, and outcome of in-hospital LT-VA in order to help clinicians in prescribing appropriate levels of monitoring.
Methods: the study population consisted of all 10,741 consecutive patients (65 ± 15 years, 67.7% males) admitted to a cardiology department in 2009–2014. Terminally ill patients and those with primary arrhythmia diagnosis were excluded. The composite end-point included sudden arrhythmic death, ventricular fibrillation, unstable ventricular tachycardia and appropriate ICD shock unrelated to invasive interventions.
Results: the incidence of LT-VA was 0.6%, with no differences regarding age, gender and primary diagnosis of coronary artery disease between patients with and without LT-VA. The incidence of LT-VA was significantly higher (1.2% versus 0.1%, $p < 0.001$) among urgent compared with elective admissions and among patients with left ventricular ejection fraction (LV-EF) <45% (1.7% versus 0.2%, $p < 0.001$). At multivariable analysis, urgent admission and LV-EF <45%, but not primary diagnosis of coronary artery disease, remained independent predictors of LT-VA. At the time of the event, 97.1% fulfilled either class I or class II indications for telemetry monitoring according to the American Heart Association guidelines. Survival to discharge with good neurological status was 70.6%.
Conclusions: acutely ill patients with heart failure and LV systolic dysfunction showed the highest rate of LT-VAs, regardless of the underlying cardiac disease (ischemic or non-ischemic). Current guidelines demonstrated high sensitivity in identifying patients at risk. These findings may favor proper utilization of telemetry monitoring resources.

Introduction

Life-threatening ventricular arrhythmias (LT-VA) such as sustained ventricular tachycardia (VT) and ventricular fibrillation (VF) are potentially fatal complications that may occur in patients admitted for cardiovascular diseases.[1]

Acute coronary syndromes are traditionally considered at high risk of LT-VA and accounted for a high rate of in-hospital deaths until cardiac telemetry monitoring was introduced in the 1960s.[2] Today, continuous ECG monitoring remains standard practice for patients with acute coronary syndrome,[3] but the spectrum of cardiovascular patients has widened to include individuals with non-ischemic heart diseases such as heart failure, cardiomyopathies, myocarditis and congenital heart diseases, who may also be at risk of in-hospital LT-VA.[4] As a consequence, clinicians are faced with the difficult task of identifying patients who most deserve admission to the limited number of telemetry beds.

Appropriate arrhythmic risk stratification of hospitalized patients is necessary for proper utilization of resources: although it

☆ A Spanish translated version of the summary of this article appears as Appendix in the final online version at http://dx.doi.org/10.1016/j.resuscitation.2015.12.019.

* Corresponding author. Fax: +39 049 8212309.
E-mail address: domenico.corrado@unipd.it (D. Corrado).

http://dx.doi.org/10.1016/j.resuscitation.2015.12.019
0300-9572/

may prevent arrhythmic death,[5,6] telemetry overprescription may contribute to overcrowding of emergency departments and intensive care units.[7–9] In 2004, the American Heart Association (AHA) published guidelines for continuous ECG monitoring,[4] but the accuracy of these recommendations for identifying patients at risk and preventing arrhythmic death remains poorly elucidated.

This study was designed to assess the incidence, determinants, and outcome of in-hospital LT-VA in patients admitted to the cardiology department with the aim of delineating the profile of at-risk patients. We also evaluated the sensitivity of current AHA guidelines for telemetry monitoring in the modern clinical setting.

Methods

Study design and end-point

The study population included all consecutive patients admitted to the division of Cardiology, University Hospital of Padova, Italy, during the study period January 2009–December 2014. The division is a third-level regional referral center and is organized into two sections: an intensive cardiac care unit with 16 beds (all with telemetry monitoring) and a cardiology ward with 40 beds (24 with telemetry monitoring, that is prescribed to patients considered at high arrhythmic risk by the attending physician). Acutely ill patients are usually admitted to the intensive cardiac care unit and then transferred to the ward when stable, with the exception of selected low-risk patients that may be admitted directly to the cardiology ward. On opposite, elective patients are routinely admitted to the ward, but they can be temporarily transferred to the intensive cardiac care unit in case of hemodynamic deterioration or following complex or complicated invasive procedures.

Information on the name, gender, age, type of admission (urgent or elective), primary diagnosis at admission, left ventricular ejection fraction (LV-EF) and occurrence of in-hospital LT-VA were routinely recorded in the management software. Primary diagnoses at admission were grouped into the following categories: (1) coronary artery disease (including acute coronary syndrome and stable coronary artery disease) (44.8%); (2) heart failure/dilated cardiomyopathy (15.6%); (3) valvular heart disease (17.5%); (4) cardiomyopathy (1.6%); (5) pericarditis/myocarditis (2.9%); (6) congenital heart disease (2.0%) and (7) other, including diagnostic evaluation of suspected cardiac diseases, syncope, chest pain or arrhythmia device complications (15.6%). For the purpose of this study, patients admitted for brady- or tachyarrhythmias and those who suffered sustained ventricular arrhythmias in the pre-hospital setting or in the emergency department were excluded from the analysis, because this cohort have indications to continuous ECG monitoring other than arrhythmic death prevention.

The study end-point was the occurrence of any "spontaneous" (i.e. unrelated to invasive interventions) in-hospital LT-VA, including unwitnessed sudden arrhythmic death, VF, hemodynamically unstable sustained VT or appropriate ICD shock on fast VT/VF ($\geq$200 bpm). Sudden arrhythmic death was defined as a patient non undergoing telemetry monitoring who was found dead, provided that autopsy investigation suggested a probable arrhythmic cause of death. Appropriateness of ICD shocks was evaluated by an experienced electrophysiologist by reviewing stored intracardiac ECG and/or telemetry monitoring data.

Evaluation of patients with events

The records of patients who suffered in-hospital LT-VA were reviewed for the following information: age, gender, diagnosis at admission, type of admission, risk factors for coronary artery disease, comorbidities and previous coronary revascularization. We evaluated the clinical status preceding the event including clinical signs of heart failure and treatment with infusive loop diuretics, anti-arrhythmic drugs, inotropic drugs or mechanical ventricular assist devices. In addition, we evaluated hemoglobin, creatinine, potassium and magnesium levels and main echocardiographic findings at the most recent assessment preceding the event.

Treatment (including need for cardiopulmonary resuscitation, number of defibrillator shocks and drug therapy) and outcome of VA were assessed. Outcome indexes included survival to the event (i.e. return of circulation) and survival to discharge. The neurological status at discharge was evaluated according to the Cerebral Performance Categories (CPC) scale (1 = good neurological status, 2 = moderate cerebral disability, 3 = severe cerebral disability, 4 = coma or vegetative state, 5 = brain death).

Sensitivity of current guidelines for electrocardiographic monitoring

We assessed whether patients fulfilled indications for cardiac arrhythmia monitoring according to the 2004 American Heart Association guidelines[4] at the time of LT-VA. Indications were divided into two categories: class I, i.e. cardiac monitoring is indicated; and class II, i.e. cardiac monitoring may be of benefit in some patients but is not considered essential for all patients. In our study, which was performed in the cardiology department setting and excluded patients with primary arrhythmia diagnosis or out-of-hospital cardiac arrest, possible class I indications included: (1) uncomplicated acute coronary syndrome for 24 h after admission or, in patients with complications such as ongoing or recurrent ischemia, development of acute heart failure or cardiogenic shock, and ventricular arrhythmias requiring an intervention such as temporary pacing, defibrillation, or intravenous anti arrhythmic drugs, for 24 h after complications have resolved; (2) critical left main coronary artery disease or equivalent awaiting revascularization; (3) for 24 h after complicated coronary revascularization, or longer if arrhythmias or ST-segment-deviation events occur in the meanwhile; (4) intra-aortic pump balloon; (5) acute heart failure/pulmonary edema, for 24 h after signs and symptoms of acute heart failure have resolved and cardiac monitoring reveals no hemodynamically significant arrhythmias; (6) critical illness with indications for intensive care. Possible class II indications included: (1) uncomplicated myocardial infarction 24 to 48 h after admission; (2) 6 to 8 h after coronary stenting or 12–24 h after coronary angioplasty without stenting; (3) subacute phase of acute heart failure while medications, device therapy, or both are being manipulated.

Statistical analysis

Results are summarized as mean $\pm$ standard deviation (SD) or median with 25–75%-iles for normally distributed and skewed variables, respectively. Normal distribution was assessed with the Shapiro–Wilk test. Categorical differences between groups were evaluated by the χ^2 test or the Fisher exact test, as appropriate. Student *T*-test was used to compare normally distributed continuous variables while the Rank Sum test to compare skewed continuous variables. 95% confidence intervals (CI) of the incidence of events were calculated according to the Poisson distribution (the distribution of rare events). A multiple logistic regression analysis model was built to identify independent predictors of in-hospital life threatening ventricular arrhythmias. A two-sided value of $p < 0.05$ was considered significant. Statistics were analyzed with SPSS version 17 (SPSS Inc, Chicago, Ill).