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Clinical paper

Clinical predictors of shockable versus non-shockable rhythms in patients with out-of-hospital cardiac arrest☆

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ABSTRACT

Aim: To identify factors associated with a non-shockable rhythm as first recorded heart rhythm.
Methods: Patients ≥18 years old suffering out-of-hospital cardiac arrest between 2001 and 2012 were identified in the population-based Danish Cardiac Arrest Registry. Danish administrative registries were used to identify chronic diseases (within 10 years) and drug prescriptions (within 180 days). A multivariable logistic regression model, including patient related and cardiac arrest related characteristics, was used to estimate odds ratios (OR) for factors associated with non-shockable rhythm.
Results: A total of 29,863 patients were included: 6600 (22.1%) patients with a shockable rhythm and 23,263 (77.9%) patients with a non-shockable rhythm. A non-shockable rhythm was associated with female gender, arrest in private home, unwitnessed arrest, no bystander CPR, and longer time to first rhythm analysis compared to patients with shockable rhythm. In the adjusted multivariable regression model, pre-existing non-cardiovascular disease and drug prescription were associated with a non-shockable rhythm e.g. chronic obstructive lung disease (OR 1.44 [95% CI: 1.32–1.58]); and the prescription for antidepressants (OR 1.49 [95% CI: 1.35–1.65]), antipsychotics (OR 2.30 [95% CI: 1.96–2.69]) analgesics (OR 1.32 [95% CI: 1.23–1.41]), corticosteroids (OR 1.64 [95% CI: 1.44–1.85]), and antibiotics (OR 1.59 [95% CI: 1.40–1.81]). In contrast, the prescription of cardiovascular drugs and a history of cardiovascular disease e.g. ischemic heart disease was associated with a lower risk of non-shockable rhythm (OR 0.66 [95% CI: 0.60–0.71]).
Conclusion: This study demonstrate that non-cardiovascular disease and medication prescription are associated with a non-shockable rhythm while cardiovascular disease and medication prescription are associated with a shockable rhythm as first recorded rhythm in patients with OHCA.

Introduction

The prognosis following out-of-hospital cardiac arrest (OHCA) is poor with a survival rate of less than 10%.[1,2] Based upon the initial rhythm analysis cardiac arrest patients are divided into non-shockable rhythms (pulseless electrical activity [PEA] and asystole) or shockable rhythms (ventricular fibrillation [VF] and pulseless ventricular tachycardia [pVT]). At present non-shockable rhythm

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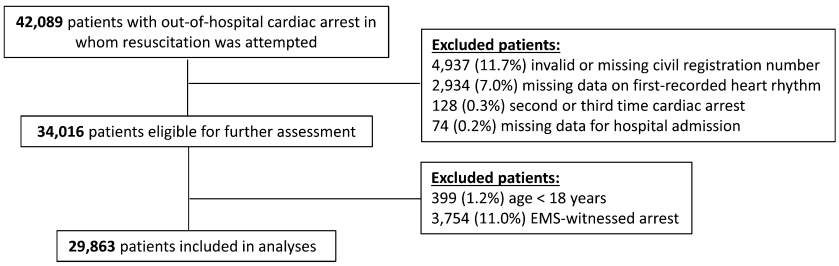

Fig. 1. Flowchart of the patient selection process for the study population.

is the most prevalent first recorded rhythm.[3,4] Survival from cardiac arrest with a non-shockable rhythm is very low and while survival from shockable rhythm in OHCA has increased to around 30%, survival following non-shockable rhythm remains low around 2–3%.[1,5] Studies have shown that increasing age,[6,7] female gender[8] and prolonged response time[9,10] is associated with a non-shockable rhythm while public location and bystander CPR is associated with a shockable rhythm.[11–13] However, the initial rhythm may also be influenced by pre-arrest patient factors such as chronic disease and medication, which have not been included in previous studies. The importance of a better understanding of predisposing modifiable factors of non-shockable rhythm is highlighted in a recent publication from the National Heart, Lung, and Blood Institute.[14] Previous studies investigating the association between chronic disease and medication and first observed rhythm have demonstrated that patients with non-shockable rhythm are more likely to have pulmonary disease, and a history of antipsychotic medication.[15,16] However, these studies included a limited number of patients, with incomplete information on timing of medication and have not been confirmed in a large nationwide cardiac arrest population with complete data on chronic disease and medication use before the cardiac arrest.

The objective was therefore to identify risk factors for having non-shockable rhythm as first recorded heart rhythm following OHCA.

Hypothesis. Patients with non-shockable and shockable rhythm are two disparate groups where patients with non-shockable rhythms are characterized by a high non-cardiovascular disease burden when compared to patients with shockable rhythms.

Methods

Study setting and population

This population-based prevalence study included patients from June 1, 2001, to December 31, 2012, in Denmark, which has approximately 5.6 million inhabitants.[17]

Definitions and recording of out-of-hospital cardiac arrest

From the Danish Cardiac Arrest Registry,[1,18] which is an ongoing prospective population-based study, we identified all individuals who were ≥18 years. An out-of-hospital cardiac arrest was defined as a clinical condition of cardiac arrest resulting in resuscitation efforts either by bystanders (with activation of the EMS system) or by EMS personnel. The EMS system is activated for all emergencies concerning cardiac arrest; and the EMS personnel is required to complete a short case report form for the Danish Cardiac Arrest Register for every cardiac arrest that resulted in resuscitation efforts.[1] From the Danish Cardiac Arrest Registry we obtained information regarding first-recorded heart rhythm (non-shockable or shockable rhythm), location of arrest (private home vs. out-of-home), witnessed/non-witnessed, bystander CPR and estimated time interval from recognition of cardiac arrest to rhythm analysis by EMS. Time of OHCA was estimated by the EMS crew based on the time at which the EMS crew received the alarm call and on interviews of bystanders on the scene.

Patients with EMS-witnessed cardiac arrest and patients with missing data on first-recorded heart rhythm were excluded from the final study population (Fig. 1).

Data on chronic diseases and prior medication use

Residents of Denmark are assigned a personal and permanent Civil Registration Number, which was used to electronically link information from the Danish population-based registries on the study population on an individual level. The Danish Civil Registration System contains information on age, sex, and survival status.[19] The Danish National Patient Registry, contains information on all hospitalizations in Denmark since 1977 and all outpatient visits and emergency department contacts since 1995 and was used to identify the disease history up to 10 years before the date of OHCA.[20] Information on dispensed prescriptions for medications were obtained up to 180 days before the date of OHCA from the National Prescription Register, which contains individual-level information on all prescriptions dispensed at all Danish pharmacies.[21] Antibiotics are normally prescribed for a shorter period why such prescriptions were only included if filled up to 14 days before OHCA. Diseases and medications prescriptions were divided into categories of cardiovascular and non-cardiovascular. A complete list of ICD-8, ICD-10 and ATC codes are provided in the supplementary online material (eTables 1 and 2).

We categorized cause of OHCA according to presumed cardiac or presumed non-cardiac cause using diagnoses codes from death certificates and discharge diagnoses codes as previously described[1] and according to the Utstein template.[22]

Statistics

This paper was prepared in compliance with the STROBE (Strengthening the Reporting of Observational Studies in Epidemiology) checklist for observational studies.[23] We tabulated the frequency and proportion of persons with non-shockable and shockable rhythm within categories of demographic variables, cardiac arrest related variables, chronic diseases and medication prescriptions. Continuous data is presented as medians together with their associated quartiles (Q25% and Q75%), while categorical data are presented as proportions. When calculating proportions and medians, observations with missing value for the covariate involved in calculation were excluded. As highlighted in Table 1, some of the observations had missing values. Therefore, we applied multiple imputation by chained equations (MICE) analysis to minimize the risk of bias due to missing data (30 imputed data sets).[24] The following variables with missing values were imputed: location of arrest, witnessed status, bystander interventions, and time interval.