

Sudden Death as the Outcome of Cardiac Arrest, in a Portuguese Region: Where Do Resuscitation Manoeuvres Stand?

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Abstract

Cardiac Arrest (CA) is a major health problem, due to short and long-term sequelæ and to associated mortality. Despite the improvement of out-of-hospital and in-hospital resuscitation manoeuvres, unexpected sudden fatal events occur. The authors reported the features of a series of sudden death (SD) cases where cardiopulmonary resuscitation (CPR) was performed. Files of 1053 medico-legal autopsies, from victims aged ≥ 18 years-old, were reviewed. Cardiac Arrest leading to Sudden Death were found in 477 cases (45.3%), but only 199 (42%) of these had been submitted to resuscitation manoeuvres. There was an elderly male predominance. Both non-cardiac and cardiac CA/SD causes were present, despite the higher coronary artery disease incidence. Both out-of-hospital and in-hospital events took place. Age, severity of the disease, co-morbidities and predominance of out-of-hospital CA were obstacles to successful CPR, leading to SD. Knowing the population characteristics may help to improve Emergency Assistance.

Keywords

Cardiac Arrest, Resuscitation Manoeuvres, Sudden Death, Portugal

1. Introduction

Cardiac Arrest (CA) is a major health problem, not only for the sequelæ it may leave—namely neurologic—, but also due to the mortality associated [1]. Worldwide, cardiac arrest incidence is estimated in 45 - 83.7 per

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100,000 persons [2]. It may have cardiac or non-cardiac causes [3] [4]. *Cardiopulmonary Resuscitation* aims to “prevent or reverse premature deaths of persons with respiratory or cardiac severe compromise or arrest” [5] [6]. Although much has been done to improve both out-of-hospital and in-hospital resuscitation manoeuvres, unexpected sudden fatal events often occur, despite age or gender. *Sudden Death (SD)* is defined as “a natural, unexpected fatal event occurring instantly or within 1 h from the onset of symptoms in an apparently healthy subject or whose disease was not so severe as to predict an abrupt outcome” [7]. When not witnessed, it is assumed sudden if “the deceased was in good health 24 h before death” [7]. *Sudden Adult Death* is the one occurring in persons aged ≥ 35 years and *Sudden Young Adult Death* happens in those whose age ranges from ≥ 18 to < 35 years [8] [9]. Around 20,000 sudden deaths are esteemed to occur every year in Portugal, an average of 55 fatalities a day [10]. Since each country has its own populational characteristics and disease profiles, analysing them may lead to changes, namely in Health Systems, that may decrease morbidity and mortality, ameliorating health care. One way to do so, is through *postmortem* examination. This article reports the features of a series of sudden death cases where *Cardiopulmonary Resuscitation (CPR)* was performed.

2. Material and Methods

Portuguese Medico-Legal Institute (INMLCF, I.P.) performs autopsies of violent and natural death victims of all ages; whether death occurred out-of-hospital or in-hospital. It has three branches—Northern, Central and Southern—that, together, cover the whole country. The authors reviewed the files of autopsies performed to victims aged ≥ 18 years-old ($n = 1053$), that died during the year 2010 at the Central Area of Portugal and Islands (Madeira, Azores), which correspond to a territorial area of 29,206 Km² and a mean population of 2,595,540 inhabitants (Figure 1). Selected variables from the autopsy reports were demographic (age, gender, race), clinical (medical history, addiction habits), circumstantial (place and manner of death, resuscitation manoeuvres), necropsic (external and internal *habitus*), anatomo-pathological (macroscopic and histological organ evaluation), toxicological and other information. Data was then submitted to descriptive statistical analysis, using Microsoft Excel 2010. Photography of the histological slides was done using *LEICA DM1000 LED* microscope and image acquisition system *LEICA ICC50 HD* camera, plus *LAS EZ v2.0.0 for Windows* software.

3. Results

Of the 1053 autopsies, Cardiac Arrest with Sudden Death occurred in 477 cases (45.3%). The time interval between CA and SD was ≤ 1 h in 217 cases and in the others was non-witnessed (≤ 24 h). Out of the 477 SD cases,



Figure 1. Map of Portugal central area and Madeira/Azores Islands (source: Google maps).

only 199 (42%) victims had been submitted to cardiopulmonary resuscitation (**Figure 2**) [11]; 161 of which belonged to the first group, that is, died within 1 h from the CA. Of the total 199 assisted victims, 139 (70%) were males and 60 (30%) females (**Figure 3**); either young adults, adults or elderly, although the 65 - 74 years age group was the most affected (**Figure 4**). All were Caucasians. The causes of Cardiac Arrest and Sudden Death are viewed on **Figure 5**. Cardiovascular diseases sum up 116 (58.29%), the majority of which is ischaemic/atherosclerotic (50.1%), as exemplified on **Figure 6**. Cardiovascular risk factors were present in the group of ischaemic victims, like cardiovascular personal antecedents—previous ischaemic incidents—(n = 48), diabetes mellitus (n = 47), systemic hypertension (n = 34), hypercholesterolemia (n = 15), smoking (n = 8) and alcoholic (n = 27) habits; some in association and most non-medicated. The following causes were respiratory, in 60 cases, namely pulmonary thromboembolism and infections like bronchopneumonia and pneumonia. The majority (n = 207/477; 43.4%) of Cardiac Arrest cases occurred at home. Most Resuscitation Manoeuvres took place during the transportation to a hospital/health center (n = 97/199; 48.74%). **Figure 7** shows where resuscitation manoeuvres were performed.

4. Discussion and Conclusion

This study shows that, in Portugal, at the territorial area evaluated during 2010, Cardiac Arrest leading to Sudden Death (45.3%) was a relevant issue. Why? What was similar to worldwide cardiac arrest/sudden death situation and what was not? What has been done to deal with this Health problem? What is planned or can still be done? The study shows that CA and SD occurred more frequently in males [3] [4], increasing with age [3] [12]. This is concordant with the literature and is, in part, due to less physiologic protection of the male gender to certain pathologic aggressions. The causes are both cardiac and non-cardiac [3] [4]. Yet, cardiovascular pathology predominates, being led by atherosclerotic (ischaemic) coronary heart disease in adults/elderly; that in our series is 50.1%, not far from data reported for the western world (60%) [13]-[15]. CA and SD may occur as the first and fatal event, or in the setting of coronary heart disease background/risk factors, although unexpected [16]. The major non-cardiac aetiology is respiratory (pulmonary thromboembolism and infections). Both cardiac and non-cardiac causes picture the national population demographic and healthy *status*; particularly at the region studied: high rate of aging persons, many living alone, with few economic resources, some in isolated places (mountain villages, ...) far from Health facilities, etc. etc. Older persons with less mobility and co-morbidities

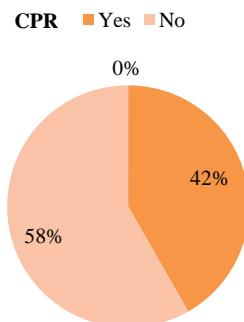


Figure 2. Distribution of CA/SD cases with CPR (source: INMLCF, I.P.; ref. [11]).

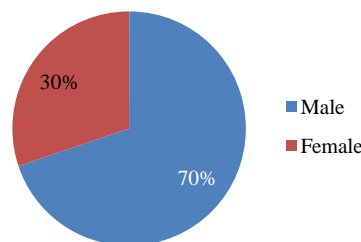


Figure 3. Gender pattern of CA/SD cases with CPR (source: INMLCF, I.P.; ref. [11]).

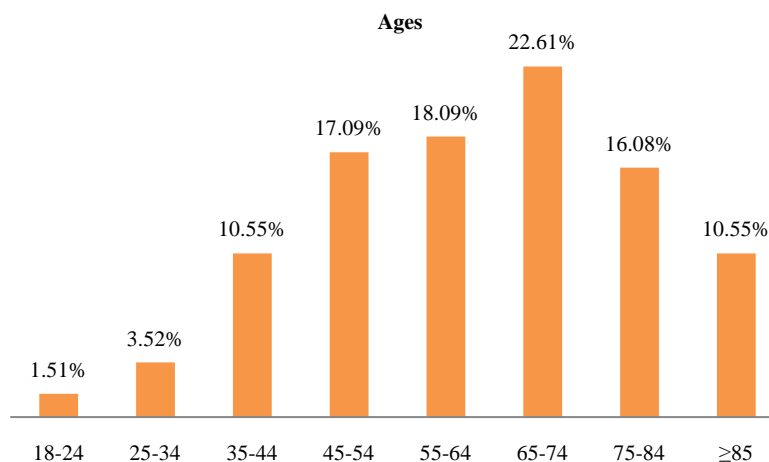


Figure 4. Age distribution of CA/SD cases with CPR (source: INMLCF, I.P.; ref. [11]).

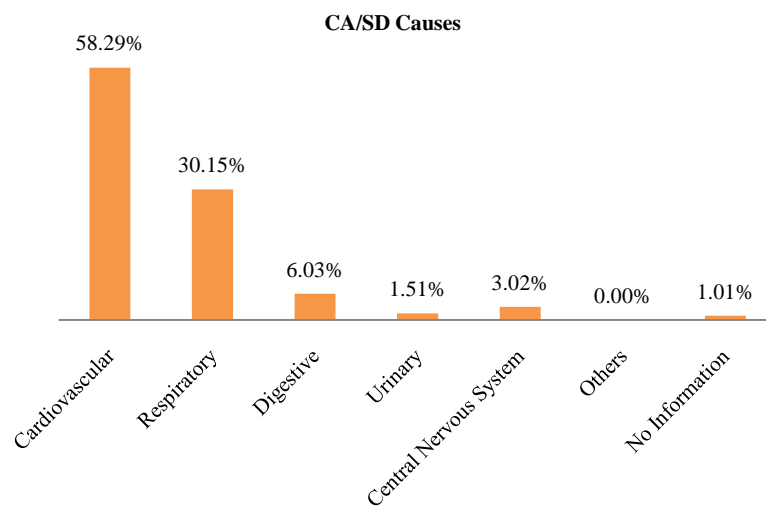


Figure 5. Causes of CA/SD cases with CPR (source: INMLCF, I.P.; ref. [11]).

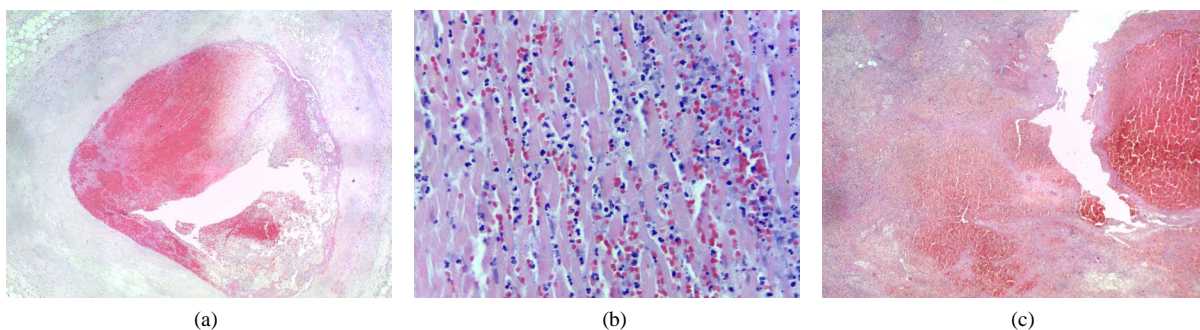


Figure 6. Histopathologic features of a SCD case caused by Coronary Heart Disease. (a) View of coronary artery atherosclerosis complicated by an occlusive thrombus [H/E 40×]; (b) Left ventricle section showing Acute Myocardial Infarction [H/E 400×], complicated by partial wall rupture in (c) [H/E 40×] (source: INMLCF, I.P.).

favour cardiac arrest and raise difficulties to cardiopulmonary resuscitation, as mentioned in the literature [3] [4] [12]. This study also showed that cardiac arrest mostly took place out-of-hospital, particularly at home, where witnesses may not exist or resuscitation manoeuvres may be delayed. Moreover, the fact that sudden death

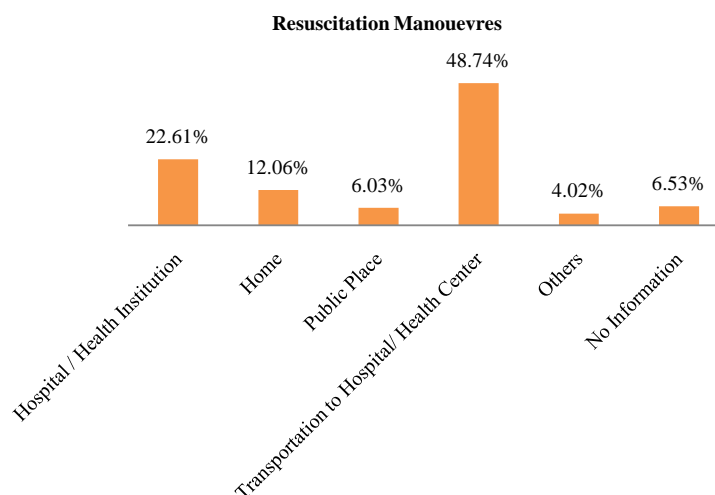


Figure 7. Place of CPR in CA/SD cases (source: INMLCF, I.P.; ref. [11]).

occurs despite the majority of cardiopulmonary resuscitation is performed by specialized teams during the transportation of the victim to a hospital/health center, reinforces the severity of causal pathology, which may not respond to the emergency assistance and thus justify the sudden fatal outcome [3] [4] [12], as exemplified by the case in **Figure 6**, where left ventricle wall rupture—as a complication of myocardial infarction—has a dismal prognosis. The disease gravity may also be a reason for the failure of in-hospital manoeuvres [17] [18]. “Portuguese Resuscitation Council (CPR)” tries 1) to provide scientific support to the health community dealing with resuscitation issues, namely by divulging International Guidelines on the subject (*i.e. European Resuscitation Council Guidelines for Resuscitation 2010*); 2) to be a “bridge” between Portugal and the world; as well as 3) to act near the Political Institutions in order to promote more and better resuscitation means [19]. “Integrated Medical Emergency System (SIEM)” exists in Portugal since 1981. It gathers multiple Institutions with the goal of assisting accidents or sudden and unexpected disease victims [20]. It is coordinated by a Health Ministry organization called “National Institute of Medical Emergency (INEM)”, which acts inside the country, but also in cooperation with other nations (signed protocols with Cape Verde in 2004, Uruguay in 2008, Brazil in 2008, Mozambique 2014). Inside the country, it has promoted the organization, logistics and professionals formation/training for in-hospital and out-of-hospital resuscitation [20]. Of all the activities and acquisitions, the authors highlight 1) the optimization/adaptation of emergency vehicles to the geography of the regional lands and severity of the nosologic situations; 2) the approval of the decree-law 188/2009, 12 August 2009 [21], legally allowing “defibrillation, via automated defibrillators, by non-medical doctors upon the delegation of a doctor and their supervision” and the alteration of that decree-law by the 184/2012, 8 August 2012 [22], where “the placement of automated defibrillators in public places is mandatory” among other improvements. Thus the regional observations of this retrospective study are of major relevance to: 1) characterize the profile of cardiac arrest leading to sudden death despite resuscitation attempt at the Central Area of Portugal and Madeira/Azores Archipelagos; 2) to compare and learn with other countries’ realities and experiences, improving the inland “chain of survival”; and 3) to promote/maintain the integration of European/International Emergency Networks, like “International Liaison Committee on Resuscitation (ILCOR)” [23].

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Conflict of Interest Statement

The authors declare no financial interests or other conflict of interest in relation to the work submitted.

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