

Retrospective study of the in-hospital sudden cardiac death at the Hospital Enrique Cabrera Cossío

Rosa M. Martínez Peró¹✉, MD, MSc; Annia M. Carrero Vázquez¹, MD, MSc; Liliam G. Cisnero Sánchez¹, MD, MSc; Yanitsy Chipi Rodríguez¹, MD; Adaimara Olivera Martínez², Stu; and Ernesto Izquierdo Rodríguez³, Stu

¹ Cardiology Department. Hospital General Docente Enrique Cabrera Cossío. Havana, Cuba.

² Medical Student. Assistant Student of Intensive Medicine. Facultad de Ciencias Médicas Enrique Cabrera, University of Medical Sciences of Havana. Havana, Cuba.

³ Medical Student. Facultad de Ciencias Médicas Enrique Cabrera, University of Medical Sciences of Havana. Havana, Cuba.

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Acronyms

AMI: acute myocardial infarction
SCD: sudden cardiac death

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✉ RM Martínez Peró.
Hospital Enrique Cabrera Cossío.
Calzada Aldabó 11117, esquina E.
Boyerros 10800. La Habana, Cuba.
E-mail address:
rmmartinez@infomed.sld.cu

ABSTRACT

Introduction: The sudden cardiac death (SCD) is a major public health problem. According to a variety studies, it is estimated that 12.5% of deaths that occur naturally are sudden, and 88% of them, of cardiac origin; hence, the sudden death represents currently one of the main challenges for healthcare systems worldwide.

Objective: To characterize the deceased by SCD at the Hospital Enrique Cabrera Cossío.

Method: Observational descriptive retrospective cross-sectional study, where natural deaths attributable to cardiac causes were studied in the period from January/2014 to August/2016 and there was determined which of these were sudden.

Results: A total of 210 cases of natural deaths that took place on the way to the hospital or in the first six hours of hospital stay were studied, the presence of cardiovascular pathological records and risk factors was reviewed, the time of the onset of symptoms, the presence, or not, of prodromes, the time in which the death occurred, the possible cause of death and the relationship between hospital time and death. There was a close relationship between the SCD and the history of high blood pressure (82.8%), previous ischemic heart disease (59.0%), smoking (58.1%) and diabetes mellitus (26.7%), as well as with the acute myocardial infarction as a trigger of death.

Conclusions: The SCD took place mainly due to cardiac arrhythmia in patients with cardiovascular risk factors, and death occurred mostly in the first hour of the in-hospital stay.

Key words: Sudden cardiac death, Risk factors, Cardiac arrhythmias

Estudio retrospectivo de muerte súbita cardiovascular intrahospitalaria en el Hospital Enrique Cabrera Cossío

RESUMEN

Introducción: La muerte súbita cardíaca (MSC) constituye un importante problema de salud pública. Según estudios realizados se calcula que el 12,5% de las

defunciones que ocurren de manera natural son súbitas y el 88% de ellas, tienen un origen cardíaco; por lo que la muerte súbita representa actualmente uno de los principales desafíos para los sistemas sanitarios a nivel mundial.

Objetivo: Caracterizar a los fallecidos por MSC en el Hospital Enrique Cabrera.

Método: Estudio observacional, descriptivo, retrospectivo, de corte transversal, donde se estudiaron las muertes naturales atribuibles a causas cardíacas en el período de enero/2014 a agosto/2016 y se determinaron cuáles de estas fueron súbitas.

Resultados: Se estudiaron 210 casos de muertes naturales ocurridas en el trayecto al hospital o en las primeras 6 horas de estadía hospitalaria, se revisó la presencia de antecedentes patológicos cardiovasculares y factores de riesgo, el tiempo de aparición de los síntomas, la presencia o no de pródromos, la hora en la que ocurrió el deceso, la posible causa de muerte y la relación entre el tiempo hospitalario y la muerte del paciente. Se encontró estrecha relación de la MSC con los antecedentes de hipertensión arterial (82,8%), cardiopatía isquémica previa (59,0%), tabaquismo (58,1%) y diabetes mellitus (26,7%), y con el infarto agudo de miocardio como desencadenante de la muerte.

Conclusiones: La MSC se manifestó principalmente por arritmia cardíaca, en pacientes con factores de riesgo cardiovascular, y el deceso ocurrió mayormente en la primera hora de estancia en el hospital.

Palabras clave: Muerte súbita cardíaca, Factores de riesgo, Arritmias cardíacas

INTRODUCTION

The sudden cardiac death (SCD) is a major public health problem. It is estimated that 12.5% of deaths occurring naturally are sudden, and 88% of cardiac origin, hence, the sudden death represents currently one of the major challenges for health systems worldwide¹.

The SCD is a form of natural death due to cardiac causes, many times to a coronary artery disease, unexpected in time and in its presentation, which is preceded by the abrupt loss of consciousness within, as a maximum, the following hour from the start of the symptoms, in an individual with a heart disease base, known or unknown¹⁻⁴. Others have proposed time limits of 2, 6 and 24 hours to the specific circumstances, as death without witnesses. It must be considered that the SCD can be recovered through adequate cardiopulmonary resuscitation maneuvers and, therefore, it can be relapsed¹⁻².

There are three diagnostic criteria in the sudden death syndrome. First, it is a natural death (not caused by external violence); second, its unexpected character (may affect completely healthy individuals as well as patients who suffer any heart disease) and third, the most controversial point: the appropriate time that must pass to consider a death as sudden. The death can appear instantly or within a short period of time (not instant), and a difference between prodromes and premonitory symptoms

should be established. The first, are symptoms of heart disease or worsening of this, appearing a few days or a week before the death takes place: increased angina, dyspnea, palpitations, easy fatigability and unspecific discomfort³⁻⁴.

The SCD is defined, according to the criteria of experts and protected by the World Health Organization (WHO), as the natural death produced by cardiac causes, preceded by the abrupt loss of consciousness, which occurs in the space of one hour after the onset of acute symptoms, in an individual with known or unknown pre-existing heart disease, but in which the time and form of death are unexpected. In the case of not being testified, it is considered sudden, if the victim was seen alive 24 hours prior to the event³.

Prospective studies have shown that approximately 50% of all deaths from coronary heart disease are sudden and unexpected, occurring shortly after (after one hour) the onset of symptoms. The absence of an official Cuban registry for the SCD makes it inaccurate to talk about rates and magnitude of the phenomenon, notwithstanding, a group of authors, led by the PhD. Luis A. Ochoa Montes⁵, has developed epidemiological studies for ten consecutive years, where more than 1.000 cases of SCD have been described, and an unexpected specific death rate has been estimated for 2011 in the range of 88.7-98.6 per 100.000 inhabitants, equivalent to a range of 11.5-2.7% of natural deaths, one SCD every 48 min-

utes.

Based on these studies, it was decided to conduct a research on deaths of cardiac origin that take place at the Hospital Enrique Cabrera Cossío, in the first six hours of the patient's arrival to the hospital.

METHOD

An observational retrospective descriptive cross-sectional study of the behavior of the in-hospital sudden death was developed, in 210 patients admitted to the Hospital General Docente Enrique Cabrera Cossío, in a period between January/2014 and August/2016, from the criteria on SCD defined by the WHO⁵.

Inclusion criteria

There were included the cases of natural death of cardiac origin in which the event occurred unexpectedly, in a time up to six hours since the beginning of the premonitory symptoms.

Exclusion criteria

Cases of traumatic death or extracardiac sudden death. Deceased cases over six hours in relation to the onset of symptoms and patients with known end-stage disease, in which the event was expected.

Variables

Demographic and clinical variables (age, sex, risk factors, electrocardiographic findings, cause of death) were analyzed. In addition, the time of occurrence of the event (in hours), related to the onset of symptoms.

It was considered as in-hospital sudden death the one that took place in the Emergency System, the Intensive Care Unit and the Minimal Care Rooms.

Collection and processing of information

The data of the studied cases were obtained from the statistical information, the death certificate, autopsy protocols, emergency, ambulatory and hospitalization medical records.

The results obtained were processed by statistical methods (frequency distribution) and they are

exposed in tables and graphs.

RESULTS

The study included 210 patients over a period of two years and eight months, distributed by year of occurrence of death, age and sex (**Table 1** y **Figure**). According to the year of occurrence of death, the patients studied were distributed in a similar way: 34.3 %, 34.8 % and 30.9 %, respectively. There was a predominance of the male sex (56.2%), and the age group between 60 and 74 (39.5%).

The cause of death taken from the death certificate (**Table 2**) of each of the patients studied concluded that the cardiac rhythm disorders –ventricu-

Table 1. Distribution of patients according to years of the study and age groups. Hospital Enrique Cabrera Cossío. January 2014- August 2016.

Age groups (Years)	2014	2015	2016*	Total	
				Nº	%
35 - 44	1	1	3	5	2,4
45 - 59	13	15	9	37	17,6
60 - 74	31	29	23	83	39,5
75 - 89	19	25	25	69	32,9
90 and over	8	3	3	16	7,6
Total n(%)	72 (34,3)	73 (34,8)	65 (30,9)	210	100

* Until August, when the collection of primary data culminated.

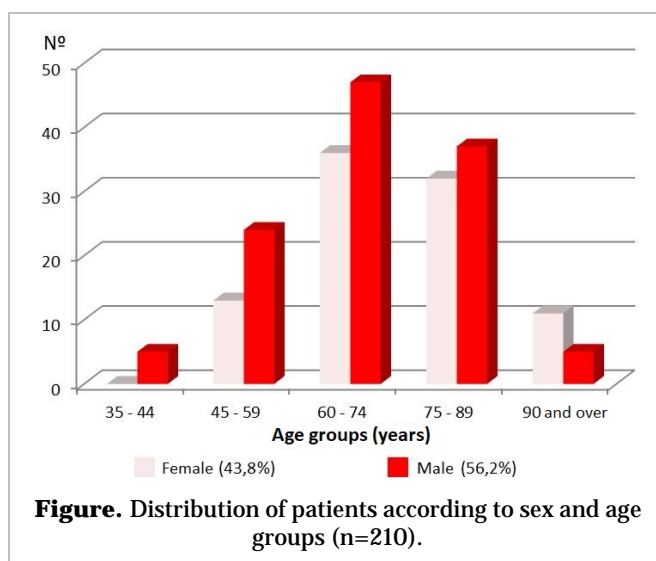


Figure. Distribution of patients according to sex and age groups (n=210).

Table 2. List of patients and causes of death according to death certificate.

Causes of death	Male	Female	Total	%
Rhythm disorders	76	64	140	66,7
Acute pulmonary edema	9	5	14	6,7
Acute myocardial infarction	17	11	28	13,3
Sudden cardiac death	5	4	9	4,3
Cardiogenic shock	4	7	11	5,2
Broken aortic aneurysm	2	0	2	0,9
Left ventricular rupture	2	0	2	0,9
Pulmonary thromboembolism	0	1	1	0,5
Other causes	3	0	3	1,4
Total	118	92	210	100

lar tachycardia, ventricular fibrillation, asystole (66.7%), followed of the acute myocardial infarction (AMI) (13.3%), with or without cardiogenic shock (5.2%), or acute pulmonary edema (6.7%), and sudden cardiac death (4.3%) were the most frequent.

By linking the patients under study according to their risk factors (**Table 3**), there was a predominance of high blood pressure (82.8%), history of ischemic heart disease (59.0%), smoking (58.1%) and diabetes mellitus (26.7 %), followed by other factors

Table 3. Risk factors (n=210).

Risk factors	Nº	%
High blood pressure	174	82,8
Smoking	122	58,1
Ischemic heart disease	124	59,0
Diabetes mellitus	56	26,7
Obesity	23	10,9
Heart failure	14	6,7
Dyslipidemias	13	6,2
Alcoholism	20	9,5
Acute myocardial infarction	12	5,7
Not collected	6	2,9
Others	9	4,3

with lower incidence.

Half of the registered deaths (50.0%) occurred in the first hour of hospital stay, followed by almost a third (29.5 %) that occurred in the second (**Table 4**).

In 16.7% of deaths, an electrocardiogram (**Table 5**) was not performed, and in the 175 of patients who had it, the more frequent findings were AMI (44.0%), followed by ventricular arrhythmias, usually secondary to myocardial ventricular fibrillation (22.3%), asystole (21.7%) and ventricular tachycardia (19.4%).

Only 34.8% of the patients were performed autopsy and

there was clinical-pathological correlation in 18.6% of the total. The time of highest incidence of death was between 06:00 and 11:59 hours.

The health areas most represented were Capdevila, Salvador Allende, Boyeros and it should be noticed the large number of patients from Arroyo Naranjos, specifically belonging to the Polyclinic of Los Pinos.

DISCUSSION

The SCD is a natural death due to cardiac causes, preceded by a sudden loss of consciousness before one hour passed from the onset of an acute change

Table 4. Time between the onset of symptoms and the occurrence of death.

Time (hours)	Nº	%
0 – 1	105	50,0
1 – 2	62	29,5
2 – 3	21	10,0
3 – 4	9	4,3
4 – 5	6	2,9
5 – 6	7	3,3
Total	210	100

Table 5. Electrocardiographic findings in the deceased patients.

Electrocardiographic findings	Nº	%
Without electrocardiogram	35	16,7
With electrocardiogram	175	83,3
- Asystole	38	21,7*
- Ventricular fibrillation	39	22,3*
- Ventricular tachycardia	34	19,4*
- Acute myocardial infarction	77	44,0*
- Electromechanical dissociation	7	4,0*
- Bradyarrhythmias	16	9,1*
- Other alterations	14	8,0*

* Percentage calculated with base on the total of electrocardiograms (175)

of the cardiovascular state⁶. A pre-existing heart disease may be known or not, but the time and form of death are unexpected. This definition incorporates as a key element the fact of being natural, quick and unexpected.

There are two ages of maximum incidence of sudden death: in the first year of life (including sudden infant death syndrome) and between 45 and 75 years of age. In the general population of infants under 1-year-old and adults of middle age or older, the incidences are strikingly similar⁷⁻⁹.

Although the overall risk of SCD in younger women is much lower, the coronary artery disease is the most frequent cause of SCD in women over 40 years, and the classic coronary risk factors, such as smoking, diabetes, hyperlipidemia and use of oral contraceptives influence the female risk¹⁰.

In the series studied herein, a higher incidence of the male sex was found, between the ages of 60 and 74 years, which corresponds to the bibliography reviewed, where it is recognized that the male sex acts as a factor that increases the appearance of SCD when associated with other risk factors¹¹.

In a study by Ochoa *et al.*¹² is deduced the existence and relationship between the sex of the victim of SCD and what is called "times of assistance to the acute cardiovascular frame" in the hospital emergency systems. Usually, at the beginning of the premonitory symptoms (precordial pain, dyspnea, palpitations, among others) men increased the waiting times, come late, thus the sudden death occurs most

often at home or other places, while women, on the other hand, once they realized about the changes in their clinical state, request medical care more quickly.

The result of the death certificates showed that cardiac rhythm disorders were the leading cause of death. Ventricular arrhythmias represent the final episode of an SCD, which is closely related to the place where the cardiac arrest occurs. The biggest percentage of patients arrived to the hospital with a cardiac arrest or had it in the first hour of stay at the hospital, associated to the gathering of several cardiovascular risk factors and the existence of a base acute or chronic ischemic heart disease. This explains that the inexplicable and sudden loss of effective circulation phenomena is usually due to arrhythmic phenomena. Patients are usually awake and active before the event, the electrical mechanism is predominantly a ventricular fibrillation episode and the terminal episode lasts a short time (less than one hour)^{12,13}.

In acute coronary syndromes, the ventricular fibrillation is 25 times more frequent in the first four hours from the onset of symptoms, that within the following 24 hours¹². The most frequent final arrhythmia is primary ventricular fibrillation, i.e., not preceded by ventricular tachycardia¹³. In the chronic ischemic heart disease in the Holter's records is demonstrated a secondary ventricular fibrillation to sustained ventricular tachycardia, responsible for the sudden death¹²⁻¹⁴.

Some authors^{15,16} point out that more than 80.0% of the adults' SCD are secondary to ventricular fibrillation episodes and occur in the absence of symptoms (instantaneously).

In the present series, the most frequent cardiovascular risk factors were high blood pressure, smoking and diabetes mellitus, together with a history of ischemic heart disease; in addition, two or more of these factors are found in many patients.

The risk profile of coronary artery disease, through the identification of the traditional atherogenic risk factors, is useful to identify risk levels in the population and individuals, but cannot be used to distinguish individual patients at risk of SCD. Multifactorial regression analyses of some of them (ex. age, diabetes mellitus, systolic blood pressure, heart rate, electrocardiographic changes, vital capacity, relative weight, tobacco consumption and smooth concentration of cholesterol) have determined that about 50% all SCD occur in 10% of the population at the highest risk decyl, depending on multiple risk

factors. In this way, the cumulative risk derived from them exceeds the simple arithmetic sum of individual risks¹⁷⁻¹⁹.

The comparison of risk factors in victims of SCD with people suffering from any of the other manifestations of coronary artery disease does not provide useful patterns by unifactorial or multifactorial analysis that distinguish potential victims of SCD from the general group. However, the history of diabetes mellitus shows a tendency to have longer corrected QT intervals in random electrocardiograms.

The high blood pressure is a risk factor for coronary heart disease clearly established, very significant for the incidence of SCD. Nevertheless, the specific risk factors for fatal arrhythmias are dynamic physiopathological episodes and occur transiently. There is a strong association between smoking and all manifestations of the coronary heart disease. The Framingham's study showed that smokers had an increased risk of sudden death from two to three times higher in each decade of life between 30 and 59 years old, and this is one of the few risk factors that is associated directly to the increased proportion of SCD due to coronary heart disease¹⁷.

The excess risk of SCD in smokers with coronary heart disease was not observed in those who had quit because their risk was similar to the ones that had never smoked¹⁷. In addition, in a study of 310 survivors of hospital cardiac arrest, the frequency of recurrent cardiac arrest was of 27% at three years of monitoring, among those who continued smoking, compared with 19% of those who quit it. In contrast, mild to moderate alcohol consumption was associated with a lower risk of SCD in men¹⁸.

Obesity is another factor that seems to influence the proportion of coronary deaths that take place suddenly. With the increase in the relative weight, the percentage of deaths from coronary heart disease that were sudden in the Framingham's study increased linearly from only 39 to 70%. The total deaths due to coronary heart disease increased with the relative weight¹⁸.

Studies of the GIMUS and PRISMA concluded that the probability of dying suddenly due to cardiovascular causes was directly proportional to the number of cardiovascular risk factors present in the population under study, with an increased risk for sudden death among those who shared three or more of these factors¹²⁻¹⁴.

In this research, patients who died with less than six hours in the emergency department have been analyzed, and more than half of those died in the

first hour after arriving to the hospital, which also coincided with the health area where they came from, all near to the hospital, corroborating the highest number of deaths of cardiac cause at home and in their way to the hospital, secondary to the speed with which rescue services are received.

The definition of time that must mediate for a death to be classified as sudden has varied according to the knowledge about this phenomenon that has existed at each stage of the scientific development. The WHO originally considered the term within 24 hours as indicative of sudden death¹⁹, afterwards, the time was reduced to six hours²⁰. In the first decade of the XXI century, although there is no general acceptance, it is considered to be enough one hour to receive medical care specializing in media health coverage, at the beginning of the acute cardiovascular episode⁴. This has led to the reduction of time in a sensitive manner, from the second decade of the XX century to the present.

In the present research the time of death was mostly daytime, which coincide with other studies that explain it through the circadian variation of adrenaline and noradrenaline, which has its acrophase in the morning, with a peak between 10:00 and 12:00 hours. The increase in the effects of these factors in the early hours of the morning promotes the increase in the rupture of the atherosclerotic plaque and the final outcome: thrombosis of the vessel, which triggers ischemia and, in most cases, processes terminating in ventricular tachyarrhythmia, ventricular fibrillation, responsible for the SCD¹⁴.

Epidemiological studies of SCD risk in populations have identified three patterns: diurnal, weekly and seasonal. They described general patterns of increased risk during morning hours, Mondays and during the winter months²⁰. One exception to the daytime risk pattern is the SCD of sleep apnea, in which the risk tends to be nocturnal¹⁵.

In the study developed herein, the autopsy was not used as inclusion criterion, but it was reviewed, because it is considered to play an important role in defining the clinical-pathological correlation of death and the time of occurrence. Tavora *et al.*²¹ agree with this approach and showed that the percentage of accuracy of the cause of death mentioned on death certificates, in cases of sudden death when the autopsy is not used, it is only 50%.

In the present research, the analysis of the main electrocardiographic findings in the cases studied showed that the AMI and old necrosis, associated with malignant ventricular arrhythmias, were the

main causes of death.

In the United States, statistics indicate that 80.0% of cases of SCD are secondary to ischemic heart disease, in 10-15% of non-coronary structural myocardial diseases (dilated or hypertrophic cardiomyopathies) and between 5-10% do not show structural abnormalities⁶. Meanwhile, Morentin and Audicana²², in a population study on SCD in a province of Spain, reported that the ischemic heart disease was the most frequent cause of death (64.8%). In 34.3% of cases was found coronary thrombosis with AMI and in 30.5%, only coronary atheromatous disease was observed, with scar myocardial infarction, without thrombosis or acute myocardial infarction.

Similar results were reported by Ochoa *et al.*⁵ in an epidemiological study on SCD, where resulted that the heart disease was responsible for the death in six of every ten episodes registered. In 49.2%, the presence of fresh thrombi in the coronaries or AMI was demonstrated, and in 11.5% was severe coronary atherosclerosis with or without chronic myocardial necrosis without acute coronary occlusion.

CONCLUSIONS

The largest proportion of patients that died due to sudden cardiac death was male, aged between 60 and 74 years, during the first hour of stay at the hospital and during day time. Ventricular tachyarrhythmias, acute myocardial infarction and acute left heart failure were the most frequent causes, as well as high blood pressure, smoking and diabetes mellitus were among the risk factors.

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