

Forensic Pathological Context of Sudden Cardiac Death

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ABSTRACT

Background: The reasons behind sudden cardiac death often remain unidentified, even after comprehensive postmortem investigations, histological assessments, and toxicological evaluations, which can result in negative autopsy findings in certain instances. This study aims to assess individuals who have experienced sudden cardiac death (SCD) and have been subjected to medico-legal autopsy. The study aims to describe the features of Sudden Cardiac Death, observe various histopathological changes in cases of sudden death and determine the frequency of association of coronary changes with sudden death.

Methods: This retrospective cross-sectional study examined 100 cases of sudden cardiac death occurring within 24 hours. During the autopsy, the heart and coronary arteries were meticulously dissected to identify any pathological conditions, and the specimens were subsequently subjected to histopathological analysis.

Results: The majority of individuals affected by sudden cardiac death (SCD) were male, accounting for 78% of cases, with the highest incidence observed in the age group of 51 to 60 years, representing 36% of the victims. Nearly 30% of those who succumbed to SCD had a survival duration ranging from 6 to 12 hours.

Conclusion: A thorough and meticulous autopsy is essential in sudden cardiac death cases to identify the precise cardiac pathology. It helps uncover structural or electrical abnormalities, guides family screening, and supports accurate diagnosis. Such evaluations are critical for improving preventive strategies and advancing understanding in forensic and clinical cardiology.

Key-words: Coronary Artery Disease, Meticulous Autopsy, Postmortem, Sudden Cardiac Death

INTRODUCTION

Sudden natural death is described as either an unnoticed death found within 24 hours in a person who had no previous symptoms or any illness that would have seemed lethal, or a sudden unexpected natural death that occurs within an hour or less of the commencement of symptoms ^[1]. The majority of these fatalities occur within an hour of the symptoms appearing, and by the time patients reach the hospital, they have already died and received as brought dead.

The cardiac etiology of sudden natural death in postmortem studies has reported 60-70% of such victims ^[2]. The incidence of sudden cardiac deaths is commonly increasing all over the world. As per the World Health Federation, 35% of all deaths are caused by cardiovascular diseases in India ^[3,4]. Up to 80% of all cases of sudden cardiac death are caused by coronary artery disease, making it the most prevalent cause ^[5]. Forensic pathologists face several challenges when sudden death occurs, and cardiac autopsies continue to be the primary diagnostic method for examining different histomorphological alterations and figuring out the prevalence of acute coronary lesions in cases of sudden cardiac death ^[6,7].

Sudden deaths are usually classified into two groups: The first group in which postmortem of death declares a lesion that is not compatible with life because of its

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extent, nature and site, for example, the rupture of an aortic aneurysm. The second group has a major proportion of deaths from natural causes. At autopsy, a lesion is found that may have contributed to death but it is also consistent with continuing life, such as coronary artery arteriosclerosis. In these situations, the absence of any other root cause of death is ambiguous but suggests that the lesion was the cause of death. As a result, in these situations, clinical history is frequently helpful in identifying the likely cause of death^[8].

Sudden natural cardiac deaths represent a considerable segment of fatalities that are subjected to autopsy for death investigation. Consequently, this study aims to assess the current landscape of sudden death within the community. It seeks to identify the causes and circumstances surrounding these deaths, thereby contributing valuable information to the judicial system. Regular dissemination of statistical data regarding sudden natural deaths offers society a clearer understanding of associated risk factors and aids in promoting lifestyle changes conducive to a healthier and longer life.

MATERIALS AND METHODS

Research design- This retrospective study was carried out on 100 autopsied hearts which were brought for a Medico-legal autopsy at Coimbatore Medical College Hospital, Coimbatore with a history of sudden death from January 2022 to December 2022. Details of these cases were obtained from police records and hospital records. The hearts were examined grossly and microscopically to observe various histopathological changes and findings were correlated clinically. All instances of sudden and/or unexpected deaths, regardless of age or gender that were referred to this institution for Autopsy examination were analyzed.

The criteria established for the selection of cases were as follows:

Inclusion criteria- Dead bodies brought to the Forensic Medicine Department, Coimbatore Medical College Hospital, Coimbatore for autopsy with a history of sudden natural death and positively identified through police papers and personal identification documents.

Exclusion criteria- Highly decomposed, mummified, skeletonized, mutilated dead bodies.

Statistical Analysis- This study utilized Microsoft Excel for data analysis. Frequencies and percentages were calculated to assess the association of coronary changes with sudden cardiac death. Descriptive statistics helped in identifying patterns and prevalence, allowing for a better understanding of the correlation between pathological findings and sudden cardiac mortality outcomes.

Ethical Approval- This study was attained from the Institutional Ethics Committee (IEC) of the Government Coimbatore Medical College before starting the study.

RESULTS

Table 1 shows that the maximum number of sudden cardiac death cases in this study population was seen in the age group of 51 to 60 years. In males, it amounted to 36% followed by 41-50 years (24%). The least number of sudden cardiac deaths occurred in the age group of 11-20 years, amounting to 1%. In females, the maximum number of sudden cardiac death cases occurred in the age group of 31-40 years, amounting to 33% followed by the 21-30 years age group (23%). No case was in the age group of 0-10 years.

Tables 1: Age and Sex wise distribution of sudden cardiac death cases

Age group (yrs)	Male		Female		Total	
	n		n	%	n	%
11-20	1	1%	0	0%	1	1%
21-30	8	10%	5	23%	13	13%
31-40	13	17%	7	33%	20	20%
41-50	19	24%	4	18%	23	23%
51-60	28	36%	3	14%	31	31%
>60	9	12%	3	14%	12	12%
Total	78	100%	22	100%	100	100%

Table 2 shows that individuals with smoking and alcohol consumption habits were more affected than those with other risk factors. Males were predominant across all identified risk factors. Among the 57 instances of sudden cardiac deaths that happened in chronic smokers, 54 cases were male and 3 were female. Additionally, 49 male chronic alcoholics were identified as significant contributors to sudden cardiac deaths. There were also two cases of sudden cardiac death associated with intravenous drug use.

Table 2: Distribution of cases based on risk factors

Predisposing Risk Factors	Male	Female	Total
Diabetes mellitus	20	8	28
Hypertension	22	10	32
Diabetes and Hypertension	12	13	25
Smoking	54	3	57
Alcohol	49	5	54
Drug abuse	2	0	2
Nil	5	8	13
Total	164	47	211

Table 3 stated that a total of 30 cases exhibited a symptom onset time, ranging from 6 to 12 hours, while 28 cases experienced onset between 12 to 24 hours. The fewest occurrences were recorded in the 00–01-hour timeframe, with only 15 cases. The majority of fatalities occurred between 1 to 6 hours after the onset of symptoms, totaling 77 cases, whereas 23 cases resulted in death within the first hour of symptom onset

Table 3: Distribution of cases based on Survival period of sudden cardiac death cases

Survival period (in hours)	Total
<1	15
1-6	27
6-12	30
12-24	28
Total	100

Table 4 shows that a significant proportion of sudden cardiac deaths examined during autopsies were attributed to coronary artery disease (CAD), accounting for 35%. Other identified cardiac causes of sudden death included cardiomyopathies (11%), atherosclerotic aorta (16%) and myocarditis (13%). Approximately 25% of cardiac deaths remained unclassified.

Table 4: Distribution of cases according to cause of death in sudden cardiac death cases

Cause of death	No of cases
Coronary artery disease (CAD)	35
Atherosclerotic aorta	16

Myocarditis	13
Hypertrophic cardiomyopathy / restrictive cardiomyopathy/ unexplained left ventricular hypertrophy	11
Unascertained	25
Total	100

DISCUSSION

Sudden cardiac death (SCD) is a most frequent and terrible event that frequently happens during a person's life and has significant effects on their surviving family members. Cardiovascular disease is responsible for almost 60% of all fatalities worldwide. Sudden cardiac death (SCD) of a young age is normal, although infrequent, is an unexpected event with social and clinical implications, and a major concern for the community. The rate of sudden cardiac death in persons aged less than 35 years is approximately one to two cases per 100,000 people per year ^[9,10]. Among adult persons aged more than 35 years, the absolute rate of sudden cardiac death markedly increases with age and sex, mostly in men, with a rate that is threefold higher than in women. However, recent studies suggest that this disparity may be declining ^[11].

To ascertain whether a sudden death is due to cardiac disease or non-cardiac conditions such as cerebral hemorrhage and pulmonary embolism, meticulous postmortem examination is necessary. Additionally, an autopsy can identify if the sudden cardiac death was caused by a mechanical (such as pulmonary thromboembolism, cardiac tamponade, etc.) or arrhythmic (mainly ventricular fibrillation) mechanism.

In India, the number of sudden cardiac deaths from coronary atherosclerosis has significantly increased, and if left unchecked, this number is certain to increase over the next several decades. In prospective studies that used standardized definitions and multiple sources of surveillance for case ascertainment, sudden cardiac death rates ranged from 40 to 100 per 100,000 in the adult general population ^[12], with the lowest rates in China ^[13]. In adults aged >35 years, particularly among white men, coronary artery disease (CAD) is generally accepted as the most common cardiac pathology that is responsible for approximately 70%–75% of SCDs ^[14].

Development of CAD rather early in life, beginning at age 20 and beyond, according to research by Sudha *et al.* ^[15]

Virmani *et al.* ^[16] and Golshahi *et al.* ^[17] The incidence of CAD in our study was 35%, which was similar to the frequencies reported by Jaiswal *et al.* ^[18] (28.9%), Yazdi *et al.* ^[19] (40%), and Garg *et al.* ^[20] (40.02%). Probably the development of several risk factors, including smoking, inactivity, stress, poor diet, and obesity. Sudden unexpected death is the most frequent complication of many forms of natural cardiac disease. Because there is no globally agreed definition of sudden cardiac death, the exact incidence is unpredictable ^[21].

CONCLUSIONS

Sudden cardiac death remains a major public health concern with significant socio-economic implications, affecting individuals across all age groups and both genders. Forensic autopsies highlight a range of contributing cardiac pathologies, many of which are preventable through early identification and intervention. A critical step in prevention is the timely recognition of high-risk individuals and the implementation of appropriate monitoring and treatment strategies. Males are disproportionately affected, with incidence rates nearly three times higher than females, underscoring the need for targeted surveillance. Establishing mandatory periodic cardiac evaluations within primary healthcare, especially for younger male populations, could substantially reduce mortality rates. Regular clinical assessments and heightened diagnostic vigilance by healthcare professionals are essential in minimizing the burden of sudden cardiac death and improving population outcomes.

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