

AUTOPSY STUDY OF HISTOPATHOLOGICAL CHANGES IN HEART IN SUDDEN CARDIAC DEATH

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ABSTRACT

Background: Sudden cardiac death (SCD) is a sudden, unexpected death that occurs when the heart stops beating or cannot pump enough blood. The aim was to investigate the incidence, histomorphological changes and demographic distribution in a selected population. **Materials and Methods:** The present study was a cross-sectional observational study conducted in the Department of Pathology in collaboration with the Department of Forensic Medicine and Toxicology, Jawaharlal Nehru Institute of Medical Sciences, Imphal, Manipur. Cadavers subjected to autopsy for suspected sudden cardiac death at Jawaharlal Nehru Institute of Medical Sciences from April 2023 to March 2025 were included in the study. **Result:** Out of a total of 180 autopsy specimens, 60 were included (incidence rate 33.34%). Largest age group was 41-50 years (28.3%). Mean age was 47.53% with male predominance (85%). A significant number of cases was seen in the 21-30 years group (15%). Most common cause was coronary artery disease (CAD) at 30%. The commonest degree of atherosclerosis (Grade IV) was seen in the left anterior descending artery (LAD). Majority of the cases had three vessel disease (64%). **Conclusion:** This study highlights the importance of preventable risk factors for cardiovascular diseases, especially for the younger age group with emphasis on early detection and treatment.

INTRODUCTION

Sudden cardiac death (SCD) has been defined by World Health Organization (WHO) as an unexpected death from a cardiac cause that occurs within one hour of symptom onset or within 24 hours of last being seen alive and symptom free. Sudden collapse or loss of consciousness, shortness of breath, chest discomfort and palpitation etc. are some of the symptoms witnessed. The relative importance of acute coronary events as a trigger is unclear,^[1] with India experiencing a steady increase in cardiac deaths over the last few decades.^[2] Despite improved resuscitation measures, the majority of individuals unfortunately do not survive.^[3]

SCD often occur without witnesses making it challenging to determine the exact circumstances surrounding the event.^[4]

Ventricular tachycardia (VT) or fibrillation is the primary underlying mechanism in approximately 75% and bradyarrhythmia or asystole in 25%.^[5] Most common cause of ventricular fibrillation is acute coronary ischaemia whereas the commonest cause of

sustained monomorphic VT in structural heart disease is myocardial scar from prior infarct. Idiopathic VT can also occur in the absence of structural heart disease.^[6]

Non-ischemic SCD are frequently linked to cardiomyopathies associated with obesity, alcoholism and fibrotic cardiomyopathy.^[7]

SCD often necessitates autopsy to determine underlying cause and identify potential inherited cardiac diseases. Thus, families that require cardiac screening can be identified.^[8]

Autopsy studies provide valuable insights into incidence, distribution and grading patterns of atherosclerotic lesions in rural and semi-urban populations.^[9]

It also helps in study of morphological features of the heart, which is impossible in the living and to correlate it with the clinical diagnosis.^[9]

In light of the rising trend in cardiovascular deaths over the past five decades, autopsy examination of heart specimens has become a critical component of medico-legal investigations.^[10]

Aim and Objective

The present study was carried out to investigate the incidence, histomorphological changes in the heart and demographic distribution (age and sex) of SCD in a selected population.

MATERIALS AND METHODS

A cross sectional observational study was conducted in the Department of Pathology in collaboration with the Department of Forensic Medicine and Toxicology, Jawaharlal Nehru Institute of Medical Sciences, Imphal, Manipur. Cadavers subjected to autopsy for suspected sudden cardiac death at Jawaharlal Nehru Institute of Medical Sciences from April 2023 to March 2025 were included in the study. Out of 180 autopsy cases received, 60 cardiac specimens of sudden cardiac death were included in the study.

Inclusion Criteria

Autopsy of cadavers with history of suspected sudden cardiac death.

Confirmed as sudden cardiac death by autopsy and histopathological examination.

Cases of pathological sudden cardiac death with consent from the relatives for including in the study.

All medico legal cases of sudden cardiac death.

Exclusion Criteria

Sudden death confirmed due to non-cardiac causes by autopsy and/or histopathological examination.

Autolysed cases.

Cases for which no consent is given in pathological sudden cardiac death.

Traumatically injured heart.

Particulars of the deceased, date of death and date of autopsy were collected from the requisition forms. Relevant history and clinical data were sought from the investigating officer and relatives. The heart specimens received from the Department of Forensic Medicine and Toxicology were examined grossly. Serial sections were made along the entire course of the major coronary arteries about 2-3mm apart. Tissue was cut at a thickness of 4-5mm and a size of 15x15mm were taken from the ventricular walls, apex and septum. Sections were also taken from papillary muscles, valves, epicardial arteries and suspicious areas. Tissues were processed and stained with hematoxylin and eosin (H&E) and the microscopic findings recorded. Atherosclerotic plaque was graded according to the American Heart Association criteria.^[11]

Collected data was entered in SPSS windows 21.0 software. Descriptive statistics like percentage, mean and proportions were used for analysis. Chi-square test was used for categorical variables. A p-value of <0.05 was considered as significant. Ethical clearance was taken from Institutional Ethics Committee, Jawaharlal Nehru Institute of Medical Sciences. Protocol No. 441/54/PGT/2023. Letter No. Ac/03/IEC/JNIMS/2018-PGT. Informed written consent was obtained from relative of the deceased.

RESULTS

A total of 180 autopsy specimens were received, out of which 60 were cardiac specimens of sudden cardiac death showing an incidence rate of 33.34%. Subjects ranged from 21 to over 70 years, with the largest group (28.3%) 41-50 years. Smallest group was seen in the 61-70 years (5.0%), while a significant number of cases were seen in the 21-30 years group (15%). Mean age was 47.53 ± 14.72 years. A strong male predominance was noted, 85% (n=51). Both the majority of male (27.45%) and female (33.3%) cases were found in the 41-50 years age group. No female was found in the 20-30 years age group and their number was low across all age brackets. The chi-square value of 8.28 and p-value of 0.141 suggest that there is no statistically significant difference in age distribution between males and females. Majority of deaths were found to occur outdoors (60%). Heart weight ranged from less than 200g to over 400g, commonest being 301-350g (30%). Mean heart weight was 363.42 ± 90.01 g. Left ventricular wall thickness was 1.57 ± 0.38 cm while right ventricular wall thickness was 0.56 ± 0.26 cm. A varied histopathological findings were observed in the study subjects [Table 2] with coronary artery disease (CAD) as the most common cause of SCD. A high prevalence of CAD (15 cases) and CAD with acute myocardial infection (14 cases) were observed in males whereas these findings were observed in 3 cases each in females. The chi-square of 59.0 and p-value of <0.0001 indicated that the distribution of histopathological findings in SCD are statistically significant. Left anterior descending artery (LAD), left circumflex artery (LCA) and right coronary artery (RCA) were graded for degree of atherosclerosis. Most common grade was Grade IV in all three arteries. Atherosclerosis was seen in the left anterior descending artery in all cases of CAD, indicating the most commonly affected artery. The majority of cases (64%) had three-vessel disease i.e. all three major coronary arteries were affected. Two-vessel and single vessel involvement were observed in 22% and 14% respectively. A chi-square value of 21.64 and p-value of 0.000 suggest that there is highly statistically significant number of coronary arteries involvement in SCD.



Figure 1: Gross appearance of dilated cardiomyopathy



Figure 2: Gross appearance of hypertensive heart disease with concentric hypertrophy of left ventricle

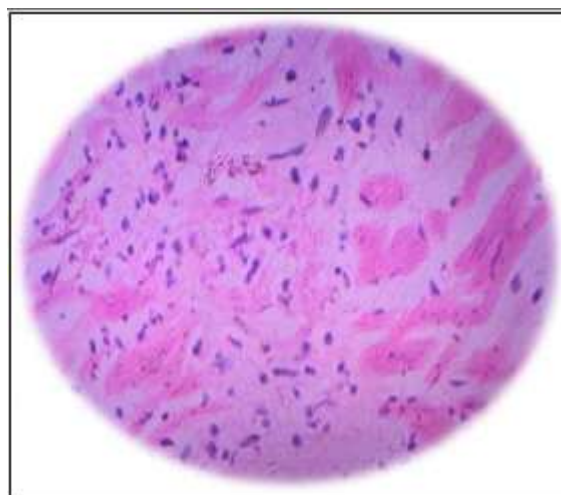


Figure 3: Acute myocardial infarction (H&E, X40)

Table 1: Age and gender wise distribution of study subjects

Age Range (years)	Male		Female	
	Frequency	Percentage	Frequency	Percentage
21-30	9	17.65	0	0.0
31-40	10	19.61	1	11.1
41-50	14	27.45	3	33.3
51-60	12	23.53	2	22.2
61-70	1	1.96	2	22.2
>70	5	9.80	1	11.1
Total	51	100.00	9	100.0

Table 2: Histopathological findings wise distribution of study subjects (n = 60)

Histopathological findings	Frequency	Percentage
CAD	18	30.00
CAD With Acute Myocardial Infarction	17	28.33
CAD With Congestive Heart Failure	2	3.33
CAD With Hypertrophied Cardiomyopathy	3	5.00
CAD With Old Myocardial Infarction	4	6.66
CAD with Hypertensive Heart Disease	6	10.00
Dilated Cardiomyopathy	1	1.66
Hypertrophied Cardiomyopathy	3	5.00
Lymphocytic Myocarditis	5	8.33
Valvular Heart Disease	1	1.66

Table 3: Degree of atherosclerosis in coronary arteries in CAD and CAD associated study subjects (American Heart Association) (n=50)

Grading	LAD	LCX	RCA
Grade I	2	1	2
Grade II	4	6	4
Grade III	10	12	7
Grade IV	18	14	12
Grade V	7	7	6
Grade VI	5	1	1
Grade VII	3	1	0
Grade VIII	1	1	0
Total	50	43	32

DISCUSSION

Cardiovascular diseases are the primary cause of mortality and incapacitation with atherosclerosis being the leading cause which is observed in almost all ethnicities and societies worldwide. Interaction of endothelial cells with modified lipoproteins, monocyte derived macrophages, T-lymphocytes and smooth muscle cells of the arterial wall are responsible for progression of the atherosclerotic

lesion. Chemokines and chemokine receptors also play important roles in atherosclerosis.

Incidence rate of SCD in this study was 33.34% which correlates with the study conducted by Shreyanka et al.^[12] The present study comprised of 60 cases with ages ranging from 21 to over 70 years, with the largest group belonging to the (28.3%) 41-50 years and the smallest group in the 61-70 years (5.0%) range. Mean age was 47.53 ± 14.72 years. These findings aligned with the study by Birare SD et al.^[13]

Studies conducted by Vyas P et al,^[14] Khanna K et al,^[15] and Yazdi SAT et al,^[16] observed progressive increase in atherosclerotic lesions with age with varying peak frequencies in the later decades. Lesser number of cases in the later decades of life in this study may be due to less number of cases being reported for autopsy study.

A strong male predominance was noted (85%) similar to the studies by Birare SD et al,^[13] Patil RN et al,^[17] and Mondal N et al.^[18] CAD and associated conditions accounted for 83.3% which corroborates with Birare SD et al,^[13] Sonawane SY et al,^[19] Vyas P et al,^[14] and Ahmad M et al.^[20] Wang H et al,^[21] observed 50.3% in their study. This variation may be due to differences in sample size, ethnicity, lifestyle, social factors and other risk factors associated with it. 16.7% of the cases in this study had different cardiovascular conditions. Increased incidence of SCD in the 21-30 years group (15%) may be primarily due to underlying inherited conditions like hypertrophic cardiomyopathy, coronary artery anomalies and primary arrhythmogenic disorders. However, changes in food habits and lack of physical activity are also contributing factors. The chi-square of 59 and p-value of <0.0001 show statistical significance between distribution of histological findings in the heart in SCD.

Mean heart weight was 363.42 ± 90.01 grams. The average heart weight was 276.19 g for males and 235.2g for females with higher average heart weight in subjects with atherosclerosis according to Vyas P et al.^[14]

Degree of atherosclerosis was assessed using the American Heart Association grading system. Advanced stages of atherosclerosis (Grade V-VIII) were observed in a significant proportion of cases, highlighting the severity of CAD in this population. LAD was the most consistently affected, which is in accordance with the studies by Yazdi SAT et al,^[16] Khanna K et al,^[15] and Patil RN et al.^[17] Extent of coronary artery involvement in CAD revealed significant number of multi-vessel disease. 64% cases of three-vessel disease were noted indicating all three major coronary arteries were affected. The chi-square analysis revealed a statistically significant association which are in concordance with Birare SD et al,^[13] (61.5%) and Patil RN et al.^[17]

Limitations: Small sample size, single institution study and autopsy reports without clinical details may not provide a complete picture of the underlying cause of sudden death.

CONCLUSION

Early detection and treatment of coronary artery disease (CAD), increased awareness and screening programs, lifestyle modifications and management of multi-vessel disease are highly important for prevention of SCD. Guidelines for managing CAD and associated conditions along with public health

initiatives are needed to raise awareness about cardiovascular health and risk factors. Further research is needed to understand the underlying mechanisms of sudden cardiac death and identify potential biomarkers. Future studies involving a larger sample size are required for a better comprehensive result.

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