

**The Study of Pathological Conditions of Heart in Medicolegal Autopsies****Dinesh S. Akarte<sup>1</sup>, Sarah Al Hinnawi<sup>2</sup>, Rajesh P. Kude<sup>3</sup>**<sup>1</sup>Associate Professor, IGGMC Nagpur<sup>2</sup>Assistant Professor, HBT Medical College & Dr. R. N. Cooper Hospital, Mumbai<sup>3</sup>Medical Officer (Forensic Medicine), District Hospital, Wardha

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**Abstract:**

**Introduction:** Cardiovascular diseases are a common cause of sudden natural deaths. In many such cases, medicolegal autopsies are requested to ascertain the cause of death. Gross and histological examination during autopsies is crucial in identifying cardiovascular diseases such as coronary artery disease, as a primary cause of natural deaths. It is important to detect conditions like atherosclerosis and myocardial infarction, which might remain undiagnosed during an individual's lifetime. Histopathological findings pointing towards specific causes of death are particularly important in cases without apparent history of heart disease.

**Materials and Methods:** This was a cross sectional study conducted in the Department of Forensic Medicine and Toxicology, Government Medical College, Nagpur. 102 autopsies which were brought to determine the cause of death were included in this study on the basis of predefined inclusion and exclusion criteria. Routine information about age, sex, brief history/ facts about the cases was collected from police inquest report, relatives, and friends of the deceased. Routine autopsy technique (Virchow's) was followed. Gross and histopathological findings particularly with respect to coronary artery disease and other cardiovascular abnormalities were noted.

**Results:** The study analyzed 102 cases, revealing a male predominance (82.35%) in natural deaths, primarily due to cardiovascular diseases. The majority of cases were in the age group of 50-60 years and belonged to the lower-middle and middle socioeconomic classes, with urban residents significantly more affected. Coronary artery disease was the leading cause of death (69.61%), with the highest incidence of severe narrowing observed in the left anterior descending artery. Histopathological findings corroborated with gross examination, indicating prevalent triple vessel disease. Additionally, left ventricular hypertrophy was one of the most common finding observed, underscoring the significant impact of cardiovascular conditions on natural mortality rates.

**Conclusion:** Coronary artery disease was found to be the most common cause of death and in majority of the cases the cause of death was chronic rather than acute. Gross and histopathological examination could identify cause of death in all cases.

**Keywords:** Natural Death, Cardiovascular Causes, Coronary Artery Disease, Histopathological Examination.

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**Introduction**

Natural death means the death which was caused entirely by disease and trauma, or poison did not play any part in bringing it about. In other words, it can be said to be the opposite of non-natural types of death such as accidental death, suicide, and homicide. [1] Among natural deaths, diseases of the cardiovascular system (45-50%) and diseases of the respiratory system (15-23%) are the leading causes of deaths. [2]

Amongst cardiovascular causes, coronary artery disease constitutes the most important single disease state that is likely to become a serious cause of disagreement on either side of the bench, in the court of law. When an apparently healthy individual dies suddenly, more so in absence of any medical examination before his death, innumerable doubts

may erupt up in the minds of not only the family physician and close relatives but also of the inquiring police officers. The medicolegal opinion may be asked about the state of the coronary artery in sudden death in road accidents, operations, and occupational diseases. Many times, it has been seen that when gross pathology could not help to evaluate the cause of death, the histology can come to the rescue of the situation and conclusive opinion could be given on the involved cardiac pathology. [3]

Examination of the coronary arteries can reveal underlying heart diseases, such as atherosclerosis, which might not have been diagnosed during the individual's lifetime. On gross examination of the heart during autopsies, abnormalities such as coronary artery atherosclerosis, myocardial

infarction (areas of coagulative necrosis), hypertrophy, and dilatation may be observed. These findings can indicate long-standing heart disease or acute events leading to death. Histopathological examination provides a more detailed view, allowing for the identification of specific changes like the presence of atheromatous plaques, thrombosis, inflammation, and fibrosis within the coronary arteries. Additionally, it can reveal microscopic evidence of myocardial ischemia, such as contraction band necrosis, and other changes indicative of chronic or acute heart failure. These examinations are essential for accurately determining the pathology of underlying heart disease and are invaluable in constructing a comprehensive post-mortem analysis. [4]

There is a significant knowledge gap that exists in detailed correlation between histopathological findings and the precise cause of death, especially in cases without evident clinical histories of heart disease. [5] While gross examination provides valuable insights, the subtler aspects of coronary artery disease and its progression, including the role of microvascular changes, inflammation, and genetic predispositions, remain underexplored.

The present study has been undertaken to find the pathological conditions present in the heart and its role in the cause of natural deaths.

### Materials and Methods

The present study was conducted in the Department of Forensic Medicine and Toxicology, Government Medical College, Nagpur. The study was an observational cross-sectional study during the period from January 2016 to November 2017 with cooperation from the Department of Pathology. 102 autopsies that were brought to determine the cause of death were included in this study on the basis of a predefined inclusion and exclusion criteria.

The minimum sample size required was found to be at least 100 cases as calculated by Open Epi-Version 3 online software, a 10% difference could be determined between the group at 90% power and 95% confidence interval, so we included 102 cases which came for medicolegal autopsies during the study period. The institutional ethics committee approved the study.

Routine information about age, sex, brief history/facts about the cases was collected from police inquest report, relatives, and friends of the deceased. In admitted cases, information was collected from hospital records and death summaries. The socio-economic status of every case was determined by using revised Kuppuswamy and BG Prasad socio-economic scales for 2016.

**Autopsy Technique:** Routine autopsy techniques (Virchow's) were followed, the thoracic cavity opened, and organs were examined in-situ before

removal. The organs were then dissected out by routine dissection technique. The heart, its great vessels and pericardium were inspected in situ for any gross findings. It was then freed from all the attachments and dissected out for examination.

The weight of the heart was recorded after the parietal pericardium has been removed, the great vessels had been trimmed to about 2cm in length and post-mortem clots had been removed from the cardiac chambers, and then the coronaries and their branches were examined individually. This was done by using a sharp scalpel and cutting transverse sections of the coronaries and their main branches at 3 mm intervals. Arteries examined included the left coronary, left circumflex, left anterior descending and right coronary arteries. The coronaries were examined for the degree of stenosis, presence of thrombus, calcification, or haemorrhage into an atheromatous plaque.

Degree of atherosclerosis was taken as the percentage of the cross-sectional area of occlusion of the lumen at the maximum point of occlusion of the respective coronary artery and graded from grade 0 to grade IV. Grade 0: Normal, Grade I: 1-25% stenosis, Grade II: 26-50% stenosis, Grade III: 51-75% stenosis, Grade IV: 76-100% stenosis. The atria were examined for any thrombi, or dilatation, the ventricles for any hypertrophy by measuring the thickness of their walls. The heart was then cut into slices about 10 mm thick by means of a long sharp knife from the apex upward till the bicuspid and tricuspid valves.

The cut surfaces of the muscles and the interventricular septum were examined for any signs of ischemia like loss of moist lustre, mottling, mottling with yellow tan infarct, yellow tan softening, red-grey depressed, infarct borders, or scarring.

The whole heart or pieces of heart showing gross pathologic changes were preserved for histopathological examination in 10% formalin solution and were forwarded to the Pathology Department. In the pathology department, slides were prepared by H&E staining and observed under a microscope at 10X power. The findings were recorded and analysed statistically.

Statistical analysis was done using SPSS version 21.0 software. Data was presented as frequency and percentages.

### Inclusion criteria

1. The admitted cases that had died due to natural diseases of cardiac cause which were then brought for post-mortem examination.
2. The cases which were brought dead in casualty and sent for post-mortem examination with the natural manner of death were included and

cardiac cause was suspected or found out at autopsy.

**Exclusion criteria**

1. The cases having unnatural means of death such as trauma, violence, or poisoning.
2. The cases where the cause of death turned out to be unnatural.

3. Dead bodies in the state of decomposition were not included in this study.

**Results**

Out of 102 cases, there were 84 males (62.97%) and 18 females (37.03%). There was a clear male predominance with a M: F ratio of 1:0.21 (Table 1).

**Table 1: Gender distribution of studied cases**

Gender	Number of cases	Percentage
Male	84	82.35
Female	18	17.65
Total	102	100

The analysis of age group showed that in a total of 102 cases that were studied, the maximum number of cases were found in the age group of 50 to 60 years (30.39%) in which males contributed 29.41% and females 0.98% followed by age group of 40-50 years (23.53%).

There were no cases in the age group of 1-10 and 20-30 years (0%). Maximum number of cases was from lower middle class, i.e. 34.31% of the total cases followed by the middle class with 32.35%. The lowest number of cases was from the lower class, i.e.

2.94%. Urban population was mostly affected which contributed to 77 cases (75.49%) in which males contributed to 63.73% and females to 11.76% and the rural population contributed to 24.51%.

The maximum number of cases survived for less than 2 hours after hospital admission, i.e. 50.98% which consisted of 42.16% males and 8.82% females which also was the maximum number of males and females followed by 2-6 hours which was in 32 cases (31.37%) (Table 2).

**Table 2: Age, Socioeconomic status, Urban vs. rural cases, and survival time in cases**

	Age	Male	%	Female	%	total	%
Age Distribution	1 -10	0	0	0	0	0	0
	11-20	0	0	2	1.96	2	1.96
	21-30	0	0	0	0	0	0.00
	31-40	8	7.84	1	0.98	9	8.82
	41-50	21	20.59	3	2.94	24	23.53
	51-60	30	29.41	1	0.98	31	30.39
	61-70	18	17.65	5	4.90	23	22.55
	71-80	5	4.90	3	2.94	8	7.84
	81-90	2	1.96	3	2.94	5	4.90
	Total	84	82.35	18	17.65	102	100
Socioeconomic status	Upper	12	11.76	2	1.96	14	13.73
	Upper Middle	14	13.73	3	2.94	17	16.67
	Middle	28	27.45	5	4.90	33	32.35
	Lower Middle	28	27.45	7	6.86	35	34.31
	Lower	2	1.96	1	0.98	3	2.94
	Total	84	82.35	18	17.65	102	100
Urban Vs Rural Cases	Rural	19	18.63	6	5.88	25	24.51
	Urban	65	63.73	12	11.76	77	75.49
	Total	84	82.35	18	16.67	102	100
Survival Time	< 2 hours	43	42.16	9	8.82	52	50.98
	2 -6 hours	27	26.47	5	4.90	32	31.37
	6-24 hours	11	10.78	3	2.94	14	13.73
	1-3 days	0	0.00	1	0.98	1	0.98
	3-7 days	2	1.96	0	0.00	2	1.96
	>7 days	1	0.98	0	0.00	1	0.98
	Total	84	82.35	18	17.65	102	100

The maximum number of cases in pathology of cardiac origin have weight 300-400 grams (50.98 %) followed by 400-500 grams (33.34 %) and only one case observed in weight range 600-700 grams (0.98 %).

In the analysis of the cause of death, the highest incidence was due to coronary artery disease alone consisting of 71 cases (69.61%), in which males contributed to 63.73% and females contributed to 5.88% followed by myocardial infarction contributing to 20.59% in which males consisted of 14.71% and females consisted of 5.88% of cases. Valvular heart disease had the least number, consisting of only 2 cases (1.96%) (Table 3).

**Table 3: Cause of death in studied cases**

Cause of Death	Male	%	Female	%	Total	%
Coronary Artery Disease	65	63.73	6	5.88	71	69.61
Coronary Artery Disease with Pulmonary Tuberculosis	3	2.94	1	0.98	4	3.92
Coronary artery disease with Emphysema	0	0.00	1	0.98	1	0.98
Cardiac Tamponade	1	0.98	2	1.96	3	2.94
Myocardial Infarction	15	14.71	6	5.88	21	20.59
Valvular Heart Disease	0	0.00	2	1.96	2	1.96
Total	84	82.35	18	17.65	102	100

The analysis of age and gender of cases of coronary atherosclerosis showed that out of 100 cases, the maximum number of cases were seen between 61-70 years age group, in which males (26%) dominated the females (5%) closely followed by 51-60 years age group (1%). The least number of cases were seen in the 31-40 years age group, in which males (5%) had a higher incidence than females (2%). Males had a higher incidence than females in all age groups except >81 years (Table 4).

**Table 4: Age and gender-wise distribution of coronary atherosclerosis in studied cases**

Age group (Years)	Number of cases of coronary atherosclerosis				Total	%
	Male	%	Female	%		
31-40	5	5.00	0	0.00	5	5.00
41-50	19	19.00	3	3.00	22	22.00
51-60	25	25.00	1	1.00	26	26.00
61-70	26	26.00	5	5.00	31	31.00
71-80	6	6.00	3	3.00	9	9.00
> 81	3	3.00	4	4.00	7	7.00
Total	84	84.00	16	16.00	100	100

The maximum number of cases of Grade 4 narrowing of coronary artery lumen was observed in LAD on gross (77.03%) and histopathological (74.39%) examination followed by gross (18.92%) and histopathological (20.73%) in RCA lumen and gross (4.05%) and histopathological (4.88%) in LCX lumen. Grade 3 was observed in maximum numbers in RCA on gross (43.92 %) and histopathological (43.57%) examination followed by LCX, gross (37.16%), and histopathological (38.57%) examination, LAD (18.92%) on gross and

(17.86%) on histopathological examination. Grade 2 had the highest incidence in LCX on gross (37.04 %) and on histopathological (37.50%) examination followed by LCA on (25.93%) gross and (6.25%) histopathological examination. LCA shows the maximum number of Grade 1 both on gross (54.54%) and histopathological (42.22%) examinations followed by LCX on gross (27.28 %) and histopathological (26.67%) examinations (Table 5).

**Table 5: Distribution of atherosclerosis and grading of narrowing of lumen of coronary artery**

Coronary artery	Grading of narrowing of lumen of coronary artery															
	Grade 1				Grade 2				Grade 3				Grade 4			
	Gross	%	Histo	%	Gross	%	Histo	%	Gross	%	Histo	%	Gross	%	Histo	%
LAD	04	9.09	08	17.78	04	14.81	03	12.50	28	18.92	25	17.86	57	77.03	61	74.39
LCX	12	27.28	12	26.67	10	37.04	09	37.50	55	37.16	54	38.57	03	4.05	04	04.88
RCA	04	9.09	06	13.33	06	22.22	06	25.00	65	43.92	61	43.57	14	18.92	17	20.73
LCA	24	54.54	19	42.22	07	25.93	06	25.00	00	00.00	00	00.00	00	00.00	00	00.00
Total	44	100	45	100	27	100	24	100	148	100	140	100	74	100	82	100

In cardiac lesions, other than narrowing of the coronary artery lumen, LVH alone is seen in maximum number of cases (53.54 %) followed by old myocardial infarction (22.83%), recent myocardial infarction (18.90 %), and LVH and RVH in combination (4.72 %) (Table 6).

**Table 6: Cardiac lesions other than narrowing of coronary artery lumen in cases**

Lesions	Number of cases	Percentage
Recent Myocardial Infarction	24	18.90 %
Old Myocardial Infarction	29	22.83 %
LVH Alone	68	53.54 %
RVH Alone	0	0 %
LVH + RVH	6	4.72%

The maximum number of cases had triple vessel disease on gross finding (46%) and on histopathological finding (47%) followed by double vessel disease on gross and histopathological finding (29%) and single vessel disease on gross finding (25%) and histopathological finding (24%) (Table 7).

**Table 7: Type of vessel disease in coronary atherosclerosis on gross and Histopathological findings**

Type	Number of cases			
	Gross	%	Histopathological	%
Single vessel disease	25	25	24	24
Double vessel disease	29	29	29	29
Triple vessel disease	46	46	47	47
Total	100	100	100	100

## Discussion

The present study was undertaken to understand the cardiac lesions in the Central Indian population. A total number of 102 cases were studied. In the present study, most of the cases showing cardiac pathology belonged to the age group of 51-60 years (30.39%). The least number of cases were observed in age groups of 0-10 years (0%) and 21-30 years (0%). Farb et al [6] showed that the maximum number of cases was of the age grouping 41-60 years. Marwah et al [7] reported maximum incidences in the age group 41-50 years. Rao et al [8] reported maximum deaths in 50-60 years group. Tyagi et al [9] reported maximum number of cases in the age group 51-60 years.

From all of the above studies, it was seen that maximum number of deaths from the underlying pathology in the thoracic cavity of cardiac origin were of age group 41-60 years which was consistent with the present study. This age group is more prone to pathological changes due to various eating habits, indiscriminate use of alcohol, smoking, and tobacco in males, sedentary lifestyle, stress and strain in life, and lack of regular medical check-ups. In females, this age group is repeatedly subjected to mental and physical stress due to social and surrounding environmental conditions and ignorance towards health problems.

In the present study, males predominated the females, with male to female ratio of 1:0.21. The study constitutes (82.35%) male and (17.65%) female which is in accordance with study of Thej et al [10] (69% males and 31% females), Rao et al [8] with a male to female ratio of 10:1, Tyagi et al [9] with male to female ratio of 4.07:1. This may be because of males earning for the family and living outside the homes for doing the same along with stressful environment and habits like tobacco and

alcohol being more in males. Most of the cases belonged to lower middle having 34.31% cases followed by middle economic group having 32.35% cases. The above findings coincided with the study of Chaudhari et al [11] who reported 36.42% cases in lower middle class and 20.87% cases in the lower class. It was very likely that these classes are more exposed to stress due to financial problems and indulged in the consumption of tobacco, bidi smoking and alcohol consumption non-maintenance of hygiene, residence in the slum area.

The urban population was predominantly affected which contributed to 75.49% in which males contributed to (63.73%) and females (11.76%). The preponderance to urban areas could be because our hospital is in the heart of the city. However, it also served the surrounding rural population of the city.

Most of the people died in less than 2 hours (50.98%) in which males contributed to 42.16% and females to 8.82% followed by 2 to 6 hrs which contributed to 31.37%. Rao et al [8] reported that maximum number of deaths was within 6 hours after the onset of symptoms (n=78, 38.24%) and Tyagi et al [9] reported that the majority of deaths were within 1-6 hours (62.04%) cases. The present study was consistent with these studies.

In the analysis of the cause of death, the highest incidence was due to coronary artery disease alone consisting of 71 cases (69.61%) in which males contributed to 63.73% and females contributed to 5.88% followed by myocardial infarction contributing to 20.59% in which male consisted of 14.71% and female consisted of 5.88% of cases. Valvular heart disease had the least number of cases consisting of 2 cases (1.96%). Our findings were consistent with the study of Rao et al [8] in which the most common cause was coronary artery disease which accounted for 56.86%, Sudha et al [12] which

stated that out of total cases that died of cardiovascular causes, 45.45% were due to coronary artery disease, Bhagora et al [13] showed that 46.82% were due to coronary artery disease, Kandy et al [14] shows that 47.50 % cases were of coronary artery disease. It was seen that coronary artery disease was the most important cause not only among deaths due to cardiovascular causes but also among all-natural deaths and these findings were consistent with the present study. Valvular heart disease was noted in 1.32% of cases in the present study. Chaudhari et al [11] reported 1.74% cases; Zanjad et al [15] reported 1.16% cases. These studies correlate with the present study.

The analysis of age and sex of cases of coronary atherosclerosis showed that out of 102 cases, the maximum number of cases was seen between 61-70 years age group, in which males (25%) dominated the females (5%). The findings were consistent with Farb et al [6] with mean age 51+/- 10 years, male 80% cases and females 20% cases, Dhruva et al [19] with maximum incidences of coronary artery disease in 6th decade, male 73.6 % cases and female 26.4% cases, Chaudhari et al [11] with maximum incidence in 51-60 years age group, male 82.61% and female 17.39% cases, Manvar et al [16] with the maximum incidence in 51-60 years age group, male 81.12 % and female 18.88 % cases. It was observed that males far predominate the females which are consistent with the present study. During reproductive life, women for reasons still unknown were remarkably spared unless they had an underlying predisposition to atherosclerosis such as diabetes mellitus and hypertension. Also, the habits of smoking and alcoholism are common in males and may have contributed to a high incidence of coronary artery disease in them.

In the present study, Grade IV (>75% coronary blockage) narrowing of the coronary artery was observed in maximum number in the left anterior descending (LAD) coronary artery with 77.03% on gross and 74.39% on histopathological examination followed by right coronary artery (RCA) in 18.92% on gross and 20.73% on histopathological examination. Grade III (50-75% Blockage) was observed in maximum number in RCA (n=65, 43.92%) followed by LCX (37.16%), LAD (18.92 %).

Prasad et al [17] reported Grade IV blockage in LAD (55.6 %), LCX (11.1%) and RCA (6.7%). Rao et al [8] reported major narrowing in LAD (42.6%), RCA (51.5%). Porwal et al [18] reported maximum involvement of LAD (46.6%), RCA (41.71 %), LCX (38.83%). Manvar et al [16] reported Grade I in RCA (9.90%) and CA (18.37%), Grade II in LCX (13.78%) and LCA (13.27%), Grade III in LAD (39.29%) and LCX (17.35%), Grade IV in LAD (4.59%) and RCA (1.53%). The present study was consistent with all the above studies except Manvar

et al [16] study. It was observed that LAD and RCA are the most commonly coronary arteries showing significant blockage of coronary arteries leading to coronary artery disease.

In the present study weight of the heart in maximum number of cases (50.98%) was observed in the range 300-400 grams followed by in the 400-500 grams range in 33.34 % cases. Maximum heart weight seen in the present study was 680 grams. Rao et al [8] reported 300-400 grams in maximum cases (42.65%) and Porwal et al [18] reported the mean weight of the heart as 303.88 grams, Dhruva et al [19] reported 270+/- 75 grams for males and 248 +/- 85 grams for females. All these were consistent with our study.

In the present study on histopathological examination recent myocardial infarction was observed in 19.83 % cases, old infarction in 23.97 % cases, left ventricular hypertrophy (LVH) in 51.24 % cases, left ventricular hypertrophy (LVH) and right ventricular hypertrophy (RVH) in combination in 4.96 % cases. Farb et al [6] reported recent (21%) and old infarction (37%). Mumtaz et al [20] reported recent (15.83%) and old infarction (40%). Chaudhari et al [11] reported recent (30.8%) and old infarction (69.2%), biventricular ventricular hypertrophy (21%), LVH (45%), RVH (4%). Rao et al [8] reported recent (24%) and old infarction (27%). Porwal et al [18] reported recent infarction (18.44%) and LVH (23.30%). The present study was consistent with the above studies.

In the present study maximum number of cases of triple vessel disease was observed on 46% of gross and 47 % cases on histopathological examination, double vessel disease observed in 29 % cases both on gross and histopathological examination, single vessel disease observed in 25 % on gross and in 24 % cases on histopathological examination. Mumtaz et al [20] reported triple (40.90%), double (22.73%) and single vessel disease in 15.15 % cases. Marwah et al [7] reported triple (52%), double (21.6%) and single vessel disease in 26.4% cases.

Dhruva et al [19] reported triple (36%), double (17%) and single vessel disease in 31 % cases. Jain et al [21] reported triple (63%), double (22%) and single vessel disease in 15 % cases. Porwal et al [18] reported triple (40%), double (37%) and single vessel disease in 15 % cases. All the above studies were consistent with the present study except more single vessel disease than double vessel disease in Marwah et al [7] and Dhruva et al [19] study. From the above studies, it was observed that triple vessel disease is observed in a maximum number of cases.

### Conclusion

In this study, it was found that in a majority of the cases the cause of death was chronic rather than acute. This shows the importance of early

intervention which may reduce the complications and incidence of sudden deaths of cardiac origin.

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