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SPECTRUM OF CARDIAC PATHOLOGICAL LESIONS IN AUTOPSY CASES AT A TERTIARY CARE CENTRE OF WESTERN INDIA: A RETROSPECTIVE STUDY

Pathology

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ABSTRACT

Introduction Cardiovascular diseases are the leading cause of global mortality, with ischemic heart disease predominating. Many cardiac lesions remain clinically silent, particularly in cases of sudden death. Autopsy remains the gold standard for definitive identification of structural and histopathological abnormalities. This study aimed to evaluate the spectrum of cardiac pathological lesions in autopsy cases, with emphasis on coronary atherosclerosis and demographic correlates. **Material and Method** A retrospective observational study was conducted at the Autopsy Section, Department of Pathology in a tertiary care hospital, Vadodara, analysing 400 medicolegal autopsy heart specimens received between January and December 2024. Gross and histopathological evaluation, including morphometric assessment of heart weight and ventricular wall thickness, was performed. Data were analysed to determine associations between demographic factors, atherosclerotic severity, and myocardial infarction (MI). **Results** Among 400 cases, males predominated (79%), with a mean age of 43.5 ± 16.3 (26-45) years. Severe atherosclerosis was most frequent in the left coronary artery (28%), whereas the aorta was comparatively spared (17.5%). MI was identified in 20% of cases, predominantly old/healed (85%), affecting the cardiac base, apex, and intraventricular septum. MI prevalence increased with age and was significantly higher in males (23% v/s 10%, p=0.007) particularly in middle age-gropus. Infarcted hearts demonstrated significantly greater weight and increased septal and right ventricular wall thickness, correlating strongly with the severity of coronary atherosclerosis ($p<0.001$), reflecting structural remodelling associated with ischemic pathology. **Conclusion** Coronary atherosclerosis was the predominant cardiac pathology, with MI strongly linked to age, male sex, and coronary severity. Autopsy-based evaluation remains essential for detecting silent cardiac disease, guiding early risk stratification, and informing preventive strategies to reduce the burden of ischemic heart disease particularly in middle age group.

KEYWORDS

Autopsy, Cardiac Pathology, Coronary Atherosclerosis, Myocardial Infarction (mi), Ischemic Heart Disease, Histopathological Examination

INTRODUCTION

Cardiovascular diseases (CVDs) remain the leading cause of mortality and morbidity worldwide, with ischemic heart disease (IHD) being the predominant contributor to both death and disability [1]. Recent epidemiological analyses indicate that CVD accounted for approximately 32% of all global deaths in 2022, with IHD and stroke responsible for nearly 85% of these fatalities[2]. The burden of CVD is rising, particularly in low- and middle-income countries, driven by population aging, urbanization, and increasing prevalence of risk factors such as hypertension, diabetes, and sedentary lifestyles[3][4].

Despite significant advances in diagnostic imaging and cardiac biomarkers, a considerable proportion of cardiac pathology remains clinically unrecognized, especially in sudden and unexpected deaths in middle age-group.[5].Autopsy remains the gold standard for definitive diagnosis, allowing precise identification of structural and histopathological abnormalities, including coronary atherosclerosis, myocardial infarction, cardiomyopathies, myocarditis, and valvular and pericardial disorders[6,7]. Autopsy studies not only detect clinically unsuspected lesions but also enhance clinicopathological correlation, provide accurate cause-of-death data, and contribute to quality assurance in medical practice [8].

Demographic factors, including age and sex, as well as comorbidities such as hypertension and diabetes mellitus, obesity, sedentary lifestyle influence the prevalence and severity of cardiac lesions[9]. In developing healthcare settings, systematic post-mortem evaluation remains an indispensable tool for epidemiological assessment, improving diagnostic accuracy, and informing preventive strategies to mitigate the burden of ischemic heart disease[10]. Accordingly, this study aimed to evaluate the spectrum and frequency of cardiac pathological findings in autopsy cases at a tertiary care centre, with emphasis on coronary changes and their distribution across age-groups and sex.

AIMS AND OBJECTIVE:

1) To evaluate the spectrum and frequency of cardiac pathological lesions in autopsy cases.
2) To assess associated changes, particularly coronary atherosclerosis, contributing to cardiac morbidity and mortality.
3) To analyze the demographic distribution of cardiac pathological lesions with respect to age and sex.

Materials and Methods

This retrospective, descriptive study was conducted at Autopsy section, Department of Pathology at a tertiary care centre in Vadodara. The study involved examination of all heart specimens obtained from medico legal autopsies at our institute.

Study Period

The study included all cases received over a period of one year, from January 2024 to December 2024.

Study Population

All medicolegal autopsy cases (MLD) received in the Department of Pathology during the study period, in which the heart specimen was submitted for examination, were included.

Inclusion Criteria

- All heart specimens received from medicolegal autopsies during the study period
- Specimens with adequate preservation for histopathological examination.

Exclusion Criteria

- Autolysed heart specimens with poor tissue preservation

Specimen Handling and Examination

All heart specimens were received in 10% neutral buffered formalin. Tissues were processed routinely, embedded in paraffin, and sectioned at 3–5 µm thickness. Sections were stained with Hematoxylin and Eosin (H&E).

ETHICS
This study was undertaken after the Institutional Ethics Committee gave its approval.

STATISTICALANALYSIS
Data were compiled in Microsoft Excel and analyzed using Jamovi (Version 2.6.25). Continuous variables (age, morphometrics) are presented as mean ± standard deviation (SD) and compared using the independent samples t-test. Categorical variables (sex, atherosclerosis grade, MI presence) are expressed as frequencies and percentages and evaluated using the Chi-square test. A two-tailed p-value < 0.05 indicated statistical significance.

RESULTS
Baseline Demographic Characteristics of the Autopsy Cohort
A total of 400 autopsy cases were retrospectively reviewed and included in this study. The demographic analysis demonstrated a marked male predominance, with male subjects accounting for 79.0% (n = 316) and female subjects constituting 21.0% (n = 84). The age of the deceased ranged from 13 to 91 years, with an overall mean age of 43.45 ± 16.34 years.

Age-wise distribution revealed that the highest proportion of cases belonged to the 36–45 years age group (20.8%, n = 83), followed closely by the 26–35 years age group (20.0%, n = 80). Individuals aged 46–55 years represented 19.8% (n = 79), while subjects aged 56–65 years accounted for 14.5% (n = 58). The lowest proportion was observed among subjects aged above 65 years (8.8%, n = 35) (Table 1).

Baseline Cardiac Morphometry
Gross examination established baseline morphometric parameters of the heart. The mean heart weight was 266.00 ± 104.63 grams, with a wide range of 60 to 820 grams. Male subjects showed a slightly higher mean heart weight (268.20 g) than female subjects (257.74 g).

The mean left ventricular wall thickness was 1.38 ± 0.41 cm, whereas the right ventricular wall thickness measured 0.73 ± 0.35 cm. The mean interventricular septal thickness was 1.29 ± 0.29 cm. Mean measurements of cardiac valves and great vessels included tricuspid valve circumference of 8.14 ± 1.14 cm, mitral valve circumference of 6.92 ± 1.16 cm, aortic circumference of 5.36 ± 1.17 cm, and pulmonary valve circumference of 4.77 ± 0.88 cm (Table 1).

Spectrum and Severity of Atherosclerotic Disease
The severity of atherosclerotic involvement varied across the examined vessels. In the left coronary artery, severe atherosclerosis was identified in 28.0% (n = 112) of cases, followed by mild changes in 27.8% (n = 111), moderate changes in 20.2% (n = 81), and normal findings in 24.0% (n = 96).

The right coronary artery showed a predominance of mild atherosclerosis in 32.2% (n = 129) of cases. Moderate and severe changes were noted in 23.2% (n = 93) and 18.2% (n = 73) of cases, respectively, while 26.2% (n = 105) of cases demonstrated normal morphology.

Aortic involvement was comparatively less severe. Half of the cases (50.0%, n = 200) showed no atherosclerotic changes, while mild, moderate, and severe disease was noted in 25.5% (n = 102), 7.0% (n = 28), and 17.5% (n = 70) of cases, respectively (Table 2, Figure 1).

Prevalence and Distribution of Myocardial Infarction
Myocardial infarction was identified in 20.0% (n = 80) of autopsy cases, while no evidence of infarction was observed in 80.0% (n = 320) of cases.

Among infarcted cases, old or healed myocardial infarction constituted the majority and was observed in 17.0% (n = 68) of the total cohort. Acute or recent myocardial infarction was identified in only 1.8% (n = 7), whereas healing myocardial infarction was present in 1.2% (n = 5) of cases (Table 2).

Topographic analysis demonstrated that myocardial damage most frequently involved the base of the heart (14.5%, n = 58), followed by the apex (13.0%, n = 52) and interventricular septum (11.8%, n = 47). Left ventricular wall involvement was observed in 5.2% (n = 21), while right ventricular wall involvement was least common at 2.8% (n = 11). Myocyte hypertrophy was documented in 6.8% (n = 27) of cases (Figure 3).

Association of Demographic Variables with Myocardial Infarction
A significant association was observed between age and myocardial infarction. Subjects with myocardial infarction had a significantly higher mean age (54.13 ± 13.63 years) compared to subjects without myocardial infarction (40.78 ± 15.88 years) ($p < 0.001$).

Age-stratified analysis demonstrated a progressive increase in myocardial infarction prevalence with advancing age. Only 2.0% of subjects aged below 26 years showed evidence of myocardial infarction. This increased to 6.0% in the 26–35 years age group, 19.0% in the 36–45 years age group, and 30.0% in subjects aged 46–55 years. The highest prevalence was observed in the 56–65 years age group (40.0%), followed by subjects aged above 65 years (31.0%) (Table 3, Figure 2).

Sex-based analysis also showed a statistically significant difference. Myocardial infarction was identified in 23.0% (n = 72) of male subjects compared to 10.0% (n = 8) of female subjects ($p = 0.007$). Acute/recent and healing infarctions were observed only in male subjects.

Association of Atherosclerosis Severity with Myocardial Infarction
The severity of atherosclerosis showed a strong correlation with myocardial infarction across all vessels ($p < 0.001$).
In the left coronary artery, myocardial infarction prevalence increased from 2.0% in normal vessels to 4.0% in mild disease, 30.0% in moderate disease, and 45.0% in severe disease. Similarly, right coronary artery involvement demonstrated an increasing trend, with myocardial infarction prevalence rising from 1.0% in normal arteries to 12.0% in mild disease, 27.0% in moderate disease, and 53.0% in severe atherosclerosis.

Aortic atherosclerosis also showed a significant association with myocardial infarction, although this association was less pronounced than that observed in the coronary vessels (Table 4).

Morphometric Variations in Infarcted and Non-Infarcted Hearts
Significant morphometric differences were observed between infarcted and non-infarcted hearts. Mean heart weight was significantly higher in infarcted hearts (325.50 ± 128.54 g) compared to non-infarcted hearts (251.13 ± 92.15 g) ($p < 0.001$).

Similarly, right ventricular wall thickness was significantly greater in infarcted hearts (0.86 ± 0.42 cm) than in non-infarcted hearts (0.70 ± 0.33 cm) ($p < 0.001$). Interventricular septal thickness was also significantly increased in myocardial infarction cases (1.35 ± 0.28 cm vs. 1.28 ± 0.29 cm; $p = 0.033$).

No statistically significant difference was observed in left ventricular wall thickness, tricuspid valve circumference, mitral valve circumference, aortic circumference, or pulmonary valve circumference between the two groups (Table 5).

Table 1: Baseline Demographic and Morphometric Characteristics (N = 400)

Variable	Frequency (n) / Mean	Percentage (%) / SD
Sex		
Male	316	79.0%
Female	84	21.0%
Age Group		
< 26 years	65	16.2%
26–35 years	80	20.0%
36–45 years	83	20.8%
46–55 years	79	19.8%
56–65 years	58	14.5%
> 65 years	35	8.8%
Cardiac Morphometry (Mean ± SD)		
Age (years)	43.45	± 16.34
Heart Weight (grams)	266.00	± 104.63
Right Ventricular Wall (cm)	0.73	± 0.35
Left Ventricular Wall (cm)	1.38	± 0.41
Intraventricular Septum (cm)	1.29	± 0.29
Tricuspid Valve (cm)	8.14	± 1.14
Mitral Valve (cm)	6.92	± 1.16

Aorta (cm)	5.36	± 1.17
Pulmonary Valve (cm)	4.77	± 0.88

Table 2: Spectrum and Distribution of Cardiac Pathologies

Pathological Finding	Category	Frequency (n)	Percentage (%)
LCA Atherosclerosis Grade	Normal	96	24.0%
	Mild	111	27.8%
	Moderate	81	20.2%
	Severe	112	28.0%
RCA Atherosclerosis Grade	Normal	105	26.2%
	Mild	129	32.2%
	Moderate	93	23.2%
	Severe	73	18.2%
Aorta Atherosclerosis Grade	Normal	200	50.0%
	Mild	102	25.5%
	Moderate	28	7.0%
	Severe	70	17.5%
Myocardial Infarction (MI)	Absent	320	80.0%
	Present	80	20.0%
Stage of Infarction	Acute/Recent MI	7	1.8%
	Healing MI	5	1.2%
	Old/Healed MI	68	17.0%
Topographic Involvement	Base	58	14.5%
	Apex	52	13.0%
	Intraventricular Septum (IVS)	47	11.8%
	Left Ventricular Wall (LVW)	21	5.2%
	Right Ventricular Wall (RVW)	11	2.8%
Myocyte Hypertrophy	Present	27	6.8%

Table 3: Association of Demographic Variables with Myocardial Infarction

Demographic Variable	No MI (n = 320)	MI Present (n = 80)	Total MI % by Group	p-value
Age Group, n (%)				< 0.001
< 26 years	64	1	2.0%	
26–35 years	75	5	6.0%	
36–45 years	67	16	19.0%	
46–55 years	55	24	30.0%	
56–65 years	35	23	40.0%	
> 65 years	24	11	31.0%	
Sex, n (%)				0.007
Female	76	8	10.0%	
Male	244	72	23.0%	
Mean Age (Years ± SD)	40.78 ± 15.88	54.13 ± 13.63	-	< 0.001

Table 4: Association of Atherosclerosis Severity with Myocardial Infarction

Vessel / Grade	No MI (n = 320)	MI Present (n = 80)	Total MI % by Grade	p-value
Left Coronary Artery (LCA)				< 0.001
Normal	94	2	2.0%	
Mild	107	4	4.0%	
Moderate	57	24	30.0%	
Severe	62	50	45.0%	
Right Coronary Artery (RCA)				< 0.001
Normal	104	1	1.0%	
Mild	114	15	12.0%	
Moderate	68	25	27.0%	
Severe	34	39	53.0%	
Aorta				< 0.001
Normal	184	16	8.0%	
Mild	69	33	32.0%	
Moderate	17	11	39.0%	
Severe	50	20	29.0%	

Table 5: Morphometric Variations in Infarcted vs. Non-Infarcted Hearts

Parameter	No MI (n = 320) Mean ± SD	MI Present (n = 80) Mean ± SD	Mean Difference	p-value
Heart Weight (grams)	251.13 ± 92.15	325.50 ± 128.54	74.38	< 0.001
Right Ventricular Wall (cm)	0.70 ± 0.33	0.86 ± 0.42	0.16	< 0.001
Intraventricular Septum (cm)	1.28 ± 0.29	1.35 ± 0.28	0.08	0.033
Left Ventricular Wall (cm)	1.38 ± 0.39	1.40 ± 0.52	0.01	0.776
Tricuspid Valve (cm)	8.10 ± 1.18	8.32 ± 0.98	0.23	0.108
Mitral Valve (cm)	6.89 ± 1.16	7.04 ± 1.18	0.15	0.293
Aorta (cm)	5.33 ± 1.16	5.46 ± 1.22	0.12	0.405
Pulmonary Valve (cm)	4.74 ± 0.88	4.89 ± 0.87	0.16	0.153

Figure 1: Comparison of Atherosclerosis Severity Across Vessels

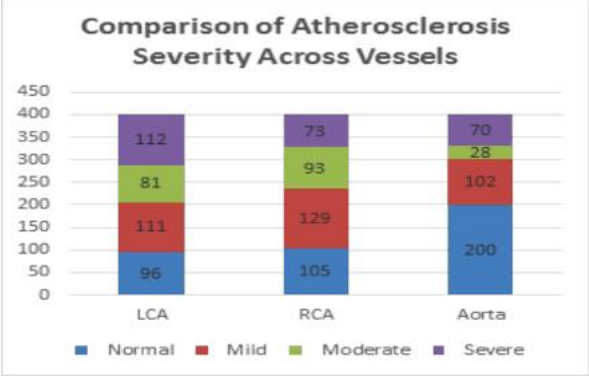


Figure 2: Prevalence of Myocardial Infarction by Age Group

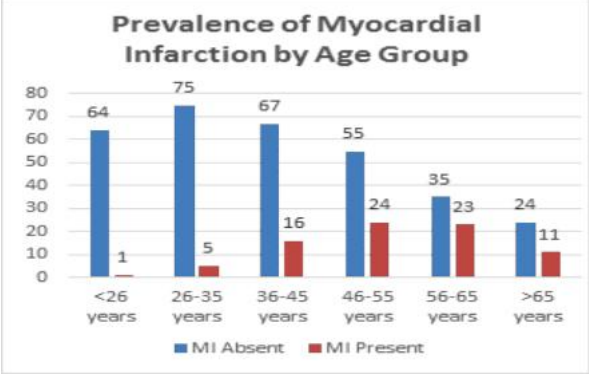


Figure 3: Topographic Distribution of Myocardial Damage

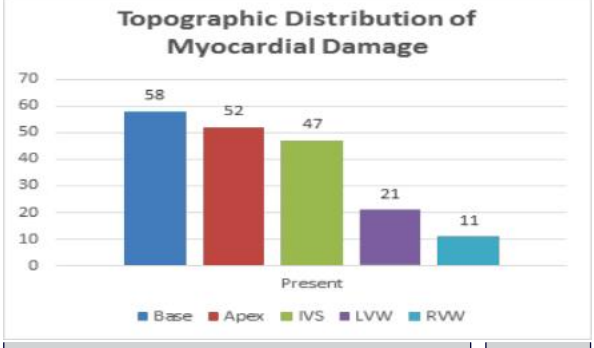
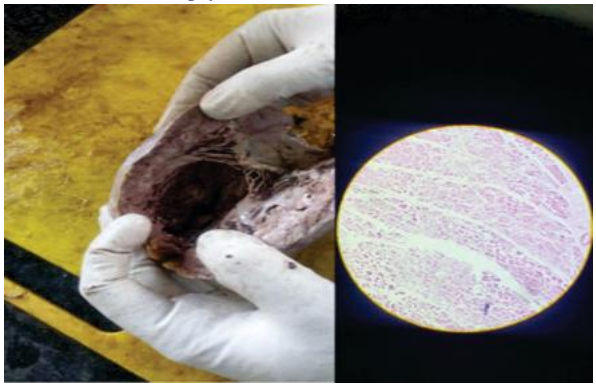


Figure 4: Microscopic and Gross Findings of myocardial infarction in an Autopsy



DISCUSSION

The present retrospective autopsy study delineates the histo-morphological spectrum of cardiac pathologies in a cohort of 400 cases from Western India, focusing on atherosclerotic disease, myocardial morphometry, and the topography of myocardial infarction (MI). Our findings underscore a profound burden of silent cardiovascular disease, corroborating global epidemiological trends that position ischemic heart disease as a pervasive, progressive threat. A staggering proportion of the cohort exhibited advanced coronary atherosclerosis and old myocardial infarctions, often established well before the sixth decade of life.

Demographic Disparities and the Shift to Younger Populations

The demographic profile of our cohort revealed a mean age of 43.45 ± 16.34 years, with the highest concentration of cases occurring between the third and fifth decades. A striking sex-based disparity was observed, with males constituting 79.0% of the subjects. This demographic distribution closely mirrors the observations by Verma et al., who reported an 83.2% male prevalence and a mean age of 42.6 years in a Northern Indian autopsy series.[10] Similarly, Rani et al. and Vincent et al. documented significant male vulnerability to cardiac lesions, attributing this trend to a higher prevalence of occupational stressors and lifestyle risk factors, such as smoking and alcohol consumption, which accelerate endothelial injury.[11,12]

Furthermore, our bivariate analysis demonstrated a robust, step-wise association between advancing age and MI risk. While infarctions were rare in the youngest demographic, prevalence surged dramatically after age 35, peaking at 40.0% in the 56-to-65-year bracket. The early onset of significant cardiac pathology in individuals under 45 years aligns seamlessly with findings from Kumar et al., who noted an alarming rise in premature coronary lesions in young adults. [13] This data collectively emphasizes that cardiovascular disease in India is no longer an affliction exclusive to the elderly, demanding a paradigm shift in how we approach screening in young, asymptomatic adults.

Topography and Severity of Atherosclerosis

Our evaluation of atherosclerosis severity revealed a distinctly non-uniform topographic distribution across the major vessels. The Left Coronary Artery (LCA) bore the highest burden of severe atheromatous disease (28.0%), whereas half of the cohort demonstrated a completely normal aorta. This suggests that atherogenesis in our demographic preferentially targets the coronary circulation before manifesting systemically. The predilection for the left coronary system is a remarkably consistent finding across forensic literature. Thej et al. and Prabhu et al. both reported maximum vulnerability in the left-sided coronary circulation, particularly the left anterior descending artery. [14,15] Furthermore, Saloni et al. found that secondary changes such as calcification and critical luminal narrowing were predominantly localized to the left coronary artery, explaining its critical role in precipitating fatal ischemic events.[16]

The aggressive gradient we observed between atherosclerosis severity and MI prevalence—peaking at 53% in severe Right Coronary Artery (RCA) disease and 45% in severe LCA disease—reinforces the direct mechanistic link between progressive luminal occlusion and myocardial necrosis. Aorta atherosclerosis, while present, proved to be a weaker independent marker for infarction compared to the coronary vessels, reinforcing that localized coronary stenosis is the primary driver of ischemic morbidity.

Chronicity and Remodeling in Myocardial Infarction

Myocardial infarction was diagnosed in exactly one-fifth (20.0%) of the evaluated hearts. Interestingly, the chronicity profile was heavily skewed toward old or healed infarctions, which accounted for 85% of all identified MIs. Acute or recent infarctions were remarkably rare (1.8%). This pattern suggests that a significant subset of the population survives initial, perhaps subclinical, ischemic insults but develops chronic ischemic remodeling. This high prevalence of healed infarctions resonates with the findings of Priya et al. , who frequently identified late-stage infarcts complicated by subsequent myocardial hypertrophy in sudden cardiac death victims.[17]

Topographically, ischemic damage was most frequently localized to the cardiac base, apex, and intraventricular septum (IVS). The relative sparing of the ventricular free walls provides a unique morphological footprint of ischemic vulnerability in this specific population. To compensate for this localized tissue death and compromised perfusion, the infarcted hearts in our study underwent profound structural remodeling. Morphometric analysis established that hearts with evidence of an MI were significantly heavier (mean 325.50 g) compared to non-infarcted hearts (251.13 g). This was characterized by statistically significant compensatory thickening of the right ventricular wall and IVS. Pandey et al. and Goswami et al. similarly observed substantial cardiomegaly and increased ventricular wall thickness in their autopsy series, noting that myocardial hypertrophy frequently coexists with, or develops subsequent to, chronic ischemic events.[18,19]

The Indispensable Role of Autopsy in Uncovering Silent Pathology

A pivotal takeaway from this study is the unmatched diagnostic value of the medico-legal autopsy. As highlighted by Chaudhary and Rai, a substantial percentage of structural cardiopathies remain clinically silent until a fatal event occurs.[20] The presence of advanced atherosclerosis and old infarctions in relatively young individuals without prior cardiac history exposes a critical gap in antemortem clinical screening. Furthermore, understanding the precise distribution patterns of ischemic lesions—such as the septal and apical fibrosis seen in our cohort—is crucial for distinguishing natural ischemic disease from non-ischemic causes of death, an approach strongly advocated by forensic pathology frameworks.[21] The reliance on systematic histopathological evaluation bridges the clinical gap, allowing for the detection of subclinical lesions that often evade standard diagnostic modalities during life.

In summary, the spectrum of cardiac pathological lesions in this Western Indian cohort reveals a high, often clinically silent, burden of ischemic heart disease driven by advanced, localized coronary atherosclerosis. The pronounced vulnerability of younger males and the sheer frequency of chronic, undetected myocardial infarctions demand urgent public health interventions. Early implementation of lifestyle modifications, targeted screening programs for subclinical atherosclerosis, and heightened clinical vigilance are imperative to curb the escalating trajectory of cardiovascular morbidity and mortality in this demographic.

CONCLUSION

In conclusion, coronary atherosclerosis was the most common cardiac lesion identified at autopsy and showed a strong association with myocardial infarction. Infarction was more frequent in males and increased markedly with advancing age, particularly in middle age. Most infarcts were old or healed, indicating a high burden of silent or previously undiagnosed ischemic heart disease. Severe coronary artery disease correlated significantly with infarction and cardiac remodeling. These findings reaffirm the importance of autopsy in detecting occult cardiovascular pathology and improving cause-of-death accuracy. Early screening and preventive strategies are essential to reduce premature cardiac mortality in India.

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