



HISTOPATHOLOGICAL SPECTRUM OF ATHEROSCLEROSIS AND ITS ASSOCIATION WITH ISCHEMIC MYOCARDIAL LESIONS: AN AUTOPSY BASED CROSS-SECTIONAL STUDY

Pathology

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ABSTRACT

Introduction: Ischemic heart disease (IHD) remains a leading cause of mortality worldwide, with atherosclerosis being the primary underlying pathological process. Autopsy studies provide valuable insights into the prevalence and morphological spectrum of atherosclerotic lesions and their correlation with ischemic myocardial changes. The aim of this study was to determine the histopathological spectrum of atherosclerosis in coronary arteries and its association with ischemic myocardial lesions in postmortem heart specimens. **Material And Methods:** A cross-sectional autopsy study was conducted over 12 months (July 2023-June 2024) on 150 postmortem heart specimens received at the Department of Pathology, Maharaja Agrasen Medical College, Agroha, Hisar, Haryana. Heart specimens were examined grossly and microscopically. Atherosclerotic lesions were graded according to the Modified American Heart Association (MAHA) classification. **Results:** Out of 150 cases, 131 (87.3%) were males and 19 (12.7%) were females. Overall prevalence of atherosclerosis was 78.0% (117/150). Left coronary artery (LCA) was involved in 78.0% cases while right coronary artery (RCA) was affected in 70.7% cases. Grade II atherosclerosis was most common in both RCA (32.1%) and LCA (26.5%). Significant atherosclerosis (Grade IV-VIII) was observed in 25.5% of RCA and 36.8% of LCA cases. Ischemic heart disease was found in 38 cases (25.3%) with chronic ischemic heart disease in 32 cases (21.3%), acute myocardial infarction in 4 cases (2.7%), and cardiac hypertrophy in 2 cases (1.3%). **Conclusions:** This study demonstrates a high prevalence of atherosclerosis and its strong correlation with ischemic heart disease. The findings emphasize the importance of early cardiovascular screening and preventive measures, particularly in high-risk populations.

KEYWORDS

Atherosclerosis, Ischemic heart disease, Myocardial infarction, Autopsy study, MAHA classification

INTRODUCTION

Ischemic heart disease (IHD) is defined as an acute or chronic form of cardiac disability arising from an imbalance between myocardial oxygen supply and demand. In more than 90% of cases, the underlying cause is reduced coronary blood flow due to atherosclerotic narrowing of coronary arteries.¹ Globally, IHD affects approximately 126 million individuals (1,655 per 100,000 population), representing about 1.72% of the world's population.² The country is projected to lose 17.9 million years of productive life by 2030 due to cardiovascular diseases, which is 9.4 times higher than anticipated losses in the United States. By 2030, cardiovascular diseases are expected to account for 33% of all deaths globally, with developing countries bearing a disproportionate burden.³ Atherosclerosis is a chronic inflammatory process affecting large and medium-sized arteries, characterized by the accumulation of lipids, inflammatory cells, and fibrous elements within arterial walls.⁴ Autopsy studies serve as an invaluable tool for understanding the prevalence, morphological patterns, and severity of atherosclerotic lesions in different populations. Despite significant advances in medical and interventional cardiology, the prevalence of coronary artery disease continues to rise, particularly in developing nations adopting westernized lifestyles.⁵

AIM AND OBJECTIVES:

Aim: To study the histopathological spectrum of atherosclerosis and its association with ischemic myocardial lesions.

OBJECTIVES

1. To estimate the morphological spectrum of atherosclerosis in coronary arteries in postmortem heart specimens.
2. To estimate the histopathological grading of atherosclerosis in coronary arteries of postmortem heart specimens.
3. To estimate the histopathological spectrum of ischemic myocardial disease in post-mortem heart specimen.

4. To determine association between atherosclerosis and ischemic heart disease in Post-mortem heart specimens.

MATERIAL AND METHODS

This hospital-based cross-sectional study was conducted in the Department of Pathology at Maharaja Agrasen Medical College (MAMC), Agroha, Hisar, Haryana, over 12 months from July 2023 to June 2024. The study included 150 consecutive formalin-fixed postmortem heart specimens received in the Pathology Department, irrespective of age, gender, and cause of death.

Exclusion Criteria: Autolysed specimens were excluded from the study.

Gross Examination

Heart specimens were weighed after removing extravenous vessels and residual blood. Dissection was performed using the inflow-outflow method. Both right and left coronary arteries were traced and sectioned at 4-5mm intervals. The exposed arteries were examined for thickening, yellow streaks, plaques, or calcification.

Microscopic Examination

Tissue sections were processed using standard histopathological techniques. Sections were stained with hematoxylin and eosin (H&E) as routine. Special stains including Von Kossa for calcification, Van Gieson for elastin, and Masson's trichrome for collagen were used when indicated (Figure 1)

Atherosclerotic lesions were graded according to the Modified American Heart Association classification⁶

- **Grade I:** Isolated intimal foamy cells
- **Grade II:** Fatty streaks (numerous intimal foamy cells in layers)
- **Grade III:** Pre-atheroma (pools of extracellular lipid)

- **Grade IV:** Atheroma (well-defined lipid core)
- **Grade V:** Fibroatheroma (lipid core with fibrous cap)
- **Grade VI:** Complicated lesion (cap defects, hemorrhage, thrombosis)
- **Grade VII:** Calcified lesion
- **Grade VIII:** Fibrotic lesion

Significant atherosclerosis was defined as Grade IV-VIII lesions.

RESULTS

Out of 150 cases studied , 131 (87.3%) were males and 19 (12.7%) were females. Weight of heart was determined to be 334.5 gm for males and 322.5 gm for females. All of these cases were divided into age group according to the age at death. (Table -1)

Table 1 Age Distribution Of Total Cases (N=150)

Age	No. of cases	Percentage
< 21	8	5.3%
21-30	31	20.7%
31-40	32	21.3%
41-50	33	22.0%
51-60	28	18.7%
61-70	15	10.0%
> 70	3	2.0%
Total	150	100.0%

The maximum cases of males were in the age group of 41-50 years (22.9% cases) and in females, maximum were in the age group of 31-40 years with 31.6% cases. (Table No. 2).

Table 2 : Age And Gender Distribution Of Total Cases (n=150)

Age (years)	Male		Female		Total		p-value
	Frequ	%	ency	%	Frequ	%	
<21	6	4.6	2	10.5	8	5.3	0.229
21-30	28	21.4	3	15.8	31	20.7	
31-40	2	19.8	6	31.6	32	21.3	
41-50	30	22.9	3	15.8	33	22	
51-60	27	20.6	1	5.3	28	18.7	
61-70	12	9.2	3	15.8	15	10	
>70	2	1.5	1	5.3	3	2	
Total	131	100	19	100	150	100	

Out of 150 specimens of heart, 117 specimens showed presence of different grades of atherosclerosis lesions in both right and left coronary arteries (Figure 1 & 2) . Thirty nine specimens did not show any atherosclerotic lesion in either of coronary arteries. Commonest prevalent atherosclerotic lesion in present study was type II (32.1%) in RCA and (26.5%) in LCA. Significant coronary artery disease (type IV to type VIII) in RCA and LCA was seen in 27 (26.4%) and 43 (36.7%) respectively. (table 3)

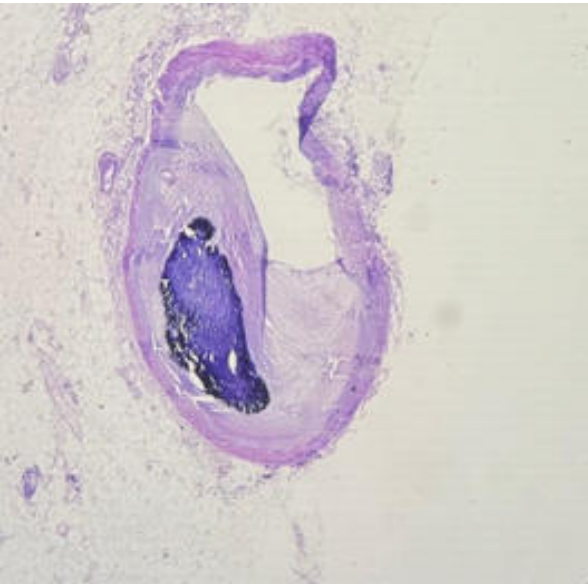


Figure 1: Atherosclerosis Grade VII with prominent calcification (H&E,40X)

Table 3: Atherosclerosis Grading Distribution

Grade	RCA n (%)	LCA n (%)
I	16 (15.1)	24 (20.5)
II	34 (32.1)	31 (26.5)
III	29 (27.4)	19 (16.2)
IV	7 (6.6)	13 (11.1)
V	12 (11.3)	13 (11.1)
VI	2 (1.9)	5 (4.3)
VII	5 (4.7)	8 (6.8)
VIII	1 (0.9)	4 (3.4)
Total	106 (100)	117 (100)
Significant (IV-VIII)	27 (25.5)	43 (36.8)

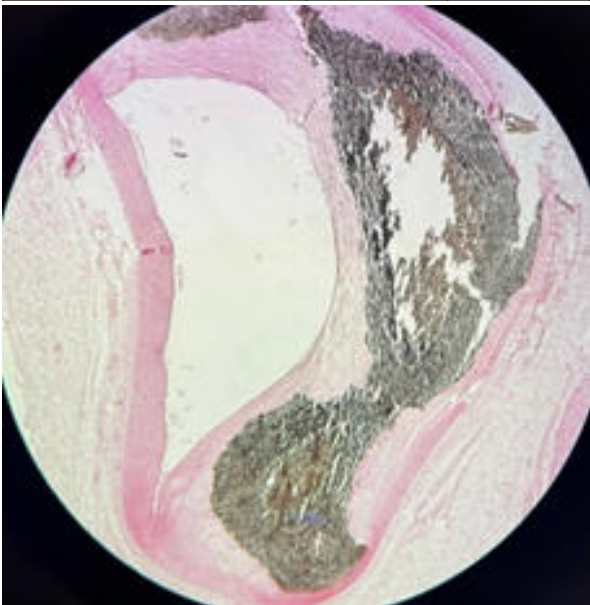


Figure 2: Atherosclerosis Grade VII (Von-Kossa stain, 100x)

IHD was observed in 38 cases (25.3%). Among these, chronic ischemic heart disease (CIHD) was found in 32 cases (21.3%), acute myocardial infarction (MI) in 4 cases (2.7%), and cardiac hypertrophy in 2 cases (1.3%) (Figure 3&4). Males constituted 32 cases (84.2%) while females accounted for 6 cases (15.8%), with a male-to-female ratio of 5.3:1. The 51-60 years age group showed the maximum number of IHD cases (13 cases, 34.2%), followed by the 41-50 and 61-70 years groups (8 cases each, 21.1%). (Table 4)

Table 4: Age-wise Distribution Of Ischemic Heart Disease (N=38)

Age Group (years)	Acute MI n (%)	Chronic IHD n (%)	Hypertrophy n (%)	Total n (%)
<21	0 (0)	0 (0)	0 (0)	0 (0)
21-30	0 (0)	1 (3.1)	0 (0)	1 (2.6)
31-40	1 (25.0)	5 (15.6)	0 (0)	6 (15.8)
41-50	2 (50.0)	5 (15.6)	0 (0)	8 (21.1)
51-60	1 (25.0)	10 (31.3)	2 (100)	13 (34.2)
61-70	0 (0)	8 (25.0)	0 (0)	8 (21.1)
>70	0 (0)	2 (6.3)	0 (0)	2 (5.3)
Total	4 (100)	32 (100)	2 (100)	38 (100)

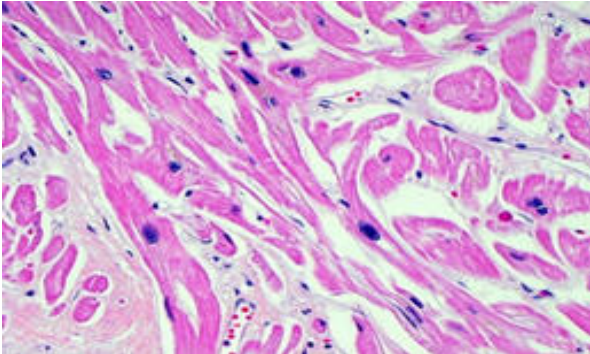


Figure 3: Ventricular Hypertrophy (H&E stain, 40X)

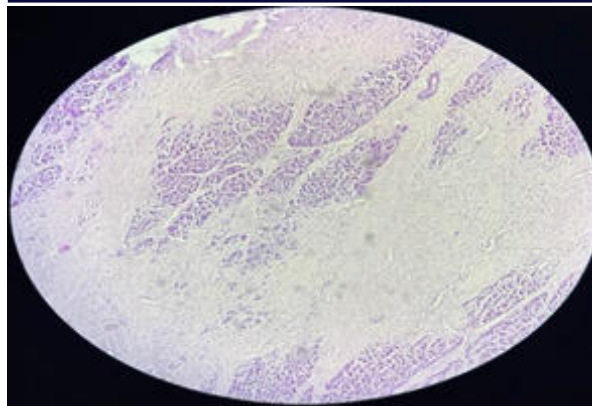


Figure 4: Chronic Ischemic Heart Disease (H&E stain, 40X)

DISCUSSION

Atherosclerosis is a common phenomenon that is seen with different prevalence in different races. It begins in childhood and progresses to young adulthood and forms the lesion that causes coronary heart disease. The autopsy study provides a means of understanding the basic process which sets the stage for clinically significant atherosclerotic cardiovascular disease. There is no valid method of sampling of living population. It was; therefore, considered that death suspected due to any reason, probably provides the best sample of the living population for studying atherosclerosis and its correlation with ischemic heart diseases.

In the present study, a total of 150 consecutive cases irrespective of age, gender and cause of death were studied out of which 131 (87.3%) were males and 19 (12.7%) were females, which is in concordance with studies of Singh H et al⁷ who had 85% of males and 15% of the females, Murthy et al⁸ with 82% of the males and 18% of the females cases & Garg M et al⁹ who observed 18.09% of males and 19.01% of females. Singh P et al also observed 73.02% male cases and 26.98% of female cases. This may be due to the protective role of the hormone oestrogen against atherosclerosis.

The overall incidence of atherosclerosis in our study was found to be 78% (117/150), this is in close concordance with the findings of Singh P et al¹⁰ who reported atherosclerosis incidence of 84.18% in their study, Vyas P et al¹¹ had the 73.45% of atherosclerosis incidence, Marwah N et al¹² with the incidence of 62.5% and Yadav M et al¹³ showed the atherosclerosis incidence of 60.7%. (Table 5)

Table 5: Comparison Of Studies Based On Incidence

Studies	Incidence of Atherosclerosis
Singh P et al ⁶⁰	84.18%
Vyas P et al ⁵⁸	73.45%
Marwah N et al ⁵⁴	62.5%
Yadav M et al ⁵³	60.7 %

In present study, Commonest prevalent atherosclerotic lesion in the present study was type II in both in right coronary artery (32.1%) and (26.5%) which is in concordance with the studies done by Varga A et al¹⁴, & Siddiqui MI et al¹⁵, they showed that the most common atherosclerotic lesion was type II (36.1%) & (48.5%) cases respectively. However, Singh P et al¹⁰, Porwal V et al¹⁶, Garg M et al⁹, & Dhurva et al¹⁷ observed most common atherosclerotic lesions as type I (27.97%), type III (40.07%), type III (30.9%) & type IV (27.4%) respectively. This could be attributed to variations in sample size.

Of the 150 postmortem heart specimens examined in this present study, 38 (25.4%) exhibited evidence of Ischemic Heart Disease (IHD) which is in concordance with the studies done by Garg M et al.⁴, Yadav M et al., Singh P et al., they also observed incidence of ischemic heart disease as 26.8%, 20.7% & 19.06% respectively. In contrast with the study conducted by Porwal V et al, which showed the incidence of Ischemic Heart Disease as 56%. This variability of the incidence of cardiac events could also be attributed to the pattern of selection of cases/sampling of tissue.

A striking male predominance was observed, with males constituting 84.2% of Ischemic Heart Disease cases as compared to 15.7% females which is in concordance with the studies done by Siddiqui et al., Jha B et al.¹⁸ & Yadav M et al¹³, they showed the male predominance as

85.7%, 92% and 100% respectively. Also, study conducted by Porwal V et al. showed male to female ratio as 3.75:1.

In our study, 38 specimens (25.3%) showed different types of significant myocardial lesions, With 4 cases (2.7%) of acute myocardial infarction, 32 cases of chronic ischemic heart disease and 2 cases (1.33%) of ventricular hypertrophy. Acute myocardial infarction reported in our study was 4 cases (2.7%) which is in concordance with the study conducted by Garg M et al, Yadav M et al, Udhreja et al.¹⁹ & Rani et al.²⁰ they reported acute myocardial infarction cases as 3%, 5%, 5.2% & 3.09% respectively. Chronic ischemic heart disease cases reported in our study was 32 (25.3%) which is in close concordance to studies of Marwah N et al¹², Garg M et al⁹ & Verma et al.²¹, they also reported chronic ischemic heart disease 25.5%, 23.7% & 21.6 % respectively. Ventricular hypertrophy cases observed in our study were 2 (1.33%) which is close to studies done by Siddiqui et al & Singh P et al., in which they showed ventricular hypertrophy cases as 4% & 5.11% respectively.

CONCLUSION

Atherosclerosis and ischemic cardiac disease continue to be major contributors to mortality and morbidity worldwide. Atherosclerosis is a common phenomenon which is seen with different prevalence with different races. In order to access the magnitude of this problem, a consecutive 150 cases study of autopsy heart sample irrespective of age, gender and cause of death was done and a significant correlation was observed between advanced atherosclerosis and cardiovascular events in form of acute myocardial infarction, chronic ischemic heart disease and ventricular hypertrophy. The results of our study emphasize the importance of early cardiovascular screening on larger number of autopsy cases, so as to detect accurate prevalence of atherosclerosis and ischemic heart disease which may contribute as aid in critical approach in reducing the global burden of cardiovascular events.

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