

■ ORIGINAL ARTICLE

## Histomorphological Study of Atherosclerotic Lesions of Coronary Artery and Aorta: An Autopsy Study

Sunita Nyamagoudar<sup>1</sup>, Ramesh BH<sup>2</sup>, Radhika C Sasturkar<sup>3</sup>

### ABSTRACT

**Background:** Cardiovascular diseases leading to atherosclerosis are rapidly increasing in Indian population. This study was formulated to assess histomorphological atherosclerotic changes in aorta and coronary arteries and grading of lesions according to American Heart Association Classification (AHA).

**Materials and Methods:** 57 heart specimens received for autopsy study were included in the study. Hearts were fixed in 10% formalin and dissected. They were examined grossly for atherosclerotic lesions in aorta and coronary arteries and subsequent microscopic sections were studied and graded according to AHA classification.

**Results:** 44(77%) cases belonged to male and 13(23%) cases belonged to female. 16(28%) cases were seen in third decade followed by 14(24.6%) and 9(15.8%) in second and fourth decades respectively. Majority of atherosclerotic lesions were noted in aorta (25) followed by LAD (10). Maximum number of lesions were in grade II with 15(26.3%) cases followed by grade IV and grade III with 13(22.8%) and 10(17.5%) cases each respectively.

**Conclusion:** Atherosclerotic lesions are rapidly increasing among younger population. Screening programs and preventive measures if implemented early can prevent these lesions and its complications.

**Keywords:** Atherosclerosis; Aorta; Coronary artery.

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### INTRODUCTION

Cardiovascular diseases (CVD) are one of the leading causes of death globally. As per the World Health Organization (WHO) factsheet, about 17.9 million (32%) of global deaths were caused by CVDs in 2019. Among these deaths, 85% were due to heart attack and stroke.<sup>1</sup> One-fifth of these deaths is noted in India especially in younger population. CVDs strike Indians a decade earlier than the western population. Causes of concern for CVD in Indians are early age of onset, rapid progression and high mortality rate. Indians are known to have the highest coronary artery disease (CAD) rates, and the conventional risk factors fail to explain this increased risk. Majority of deaths happen at home without knowing the exact cause of death. Hospital-based morbidity and mortality data may not be representative of overall disease burden.<sup>2</sup>



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Coronary artery disease due to atherosclerosis has become a major social epidemic in India. Atherosclerosis is a chronic degenerative condition manifesting with thickened arterial wall.<sup>3</sup> It is initiated by lipid retention, oxidation, and modification, which provoke chronic inflammation, ultimately causing thrombosis or stenosis. Most common risk factors include hypertension, tobacco smoking, diabetes mellitus, obesity, and genetic predisposition; the molecular details of how they work are not yet known.<sup>4</sup> Assessment of atherosclerotic lesions in living population is difficult as it is invasive and expensive. Hence autopsy studies are proving helpful in studying these lesions in developing countries. The aim of this study was to evaluate the incidence and severity of atherosclerotic lesions in coronary arteries and aorta in different age groups among the autopsy specimens we received.

**MATERIALS AND METHODS**

This study was conducted from January 2019 to August 2021 at Department of Pathology, Raichur Institute of Medical Sciences, Raichur. The hearts received with medico-legal autopsy cases were included in the study. Written informed consent was taken from the relative/guardian of the deceased patient. The study was ethically approved by Institute's ethical committee. 57 hearts were included in the study. Received hearts were fixed in 10% formalin, weighed and then dissected using inflow-outflow method. Gross examination of heart, coronary arteries and aorta was done. Coronary

arteries mainly Right coronary artery (RCA), Left circumflex artery (LCX) and Left anterior descending artery (LAD) were examined for thickening of wall, thrombus, luminal narrowing. The coronary arteries were sectioned at 5mm intervals to look for presence or absence of atherosclerotic plaques. Aorta was examined for thickening of wall, presence and nature of atheromatous lesions including fatty streak, presence of calcification.

Multiple sections were taken from representative areas. After routine processing and paraffin embedding, 4µm sections were taken and stained with Hematoxylin-Eosin. All the histological sections were examined microscopically for presence of atherosclerotic lesions. All the atherosclerotic lesions were graded according to American Heart Association.<sup>5</sup> It is as given below:

- Type I: Initial lesion with foam cells
- Type II: Fatty streak with multiple foam cell layers
- Type III: Preatheroma with extracellular lipid pools
- Type IV: Atheroma with a confluent extracellular lipid core
- Type V: Fibroatheroma
- Type VI: Complex plaque with possible surface defect, hemorrhage, or thrombus
- Type VII: Calcified plaque
- Type VIII: Fibrotic plaque without lipid core

**RESULTS**

Out of the 57 hearts included in the study, majority of them were in 3rd decade of life

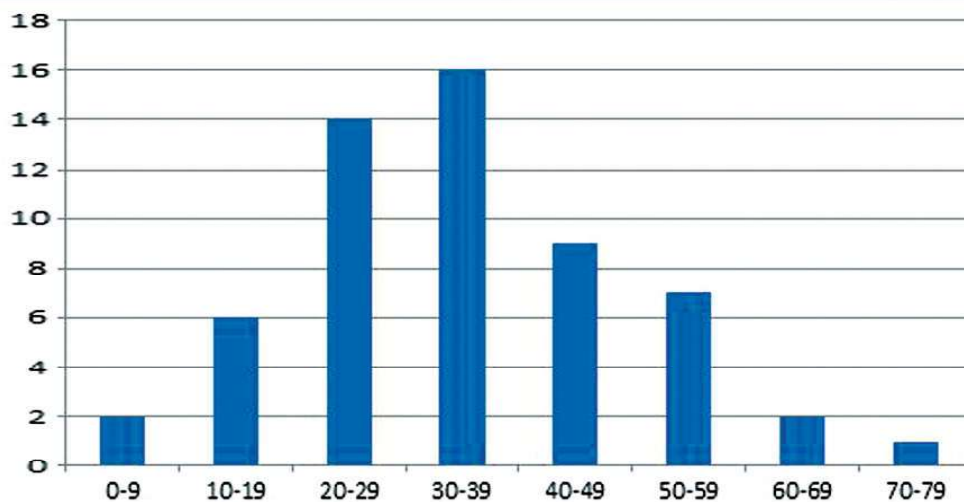


Fig. 1: Distribution of atherosclerotic lesions according to age group.

16(28%) followed by 2nd decade 14(24.6%) and then 4th decade 9(15.8%). Distribution of atherosclerotic lesions according to age is given in figure 1. 44(77%) of cases were male and 13(23%) cases were female. 4 cases had associated myocardial infarction.

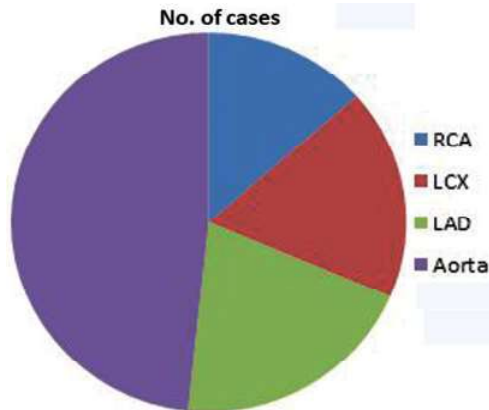


Fig. 2: Distribution of atherosclerotic lesion in aorta and coronary arteries.

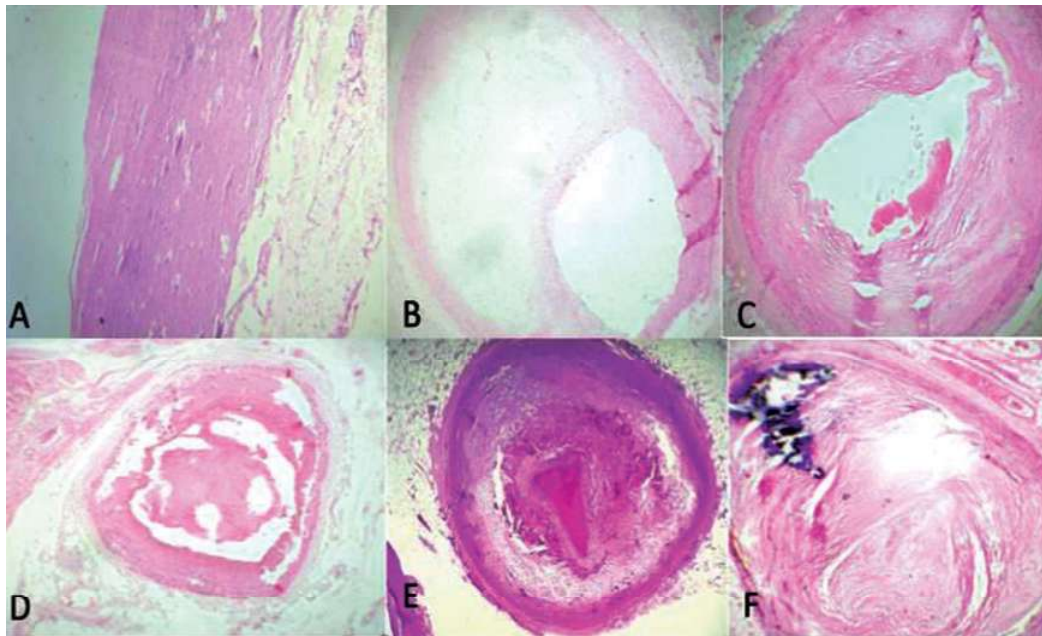
Majority of atherosclerotic lesions were noted in aorta which accounted for 25(43.8%) of cases followed by LAD which showed lesions in 10(17.5%) of cases. 9(15.8%) of LCX and 7(12.3%) of RCA showed atherosclerotic lesions. The frequency distribution of these lesions in aorta and coronary artery is given in figure 2.

Grossly aorta and coronary arteries were checked thoroughly for atherosclerotic lesions. Gross photographs of few of the lesions as depicted in figure 3.

Microscopically aorta and coronary arteries were studied and athermanous lesions were graded according to American Heart Association Classification with few of them depicted in figure 4. Majority of the lesions were noted in grade II with 15(26.3%) cases followed by grade IV and grade III with 13(22.8%) and 10(17.5%) cases each respectively. Only two cases of grade VII and one case each of grade IV and grade V were noted.



Fig. 3: Gross photographs of atherosclerotic lesions: A, B- Aorta. C, D- Coronary arteries. Atherosclerotic lesion with thrombus noted in RCA in D.



**Fig. 4:** Microphotographs of atherosclerotic lesions: A- Grade II lesion in Aorta. B, C, D, E, F- Grade III, IV, V, VI, VIII lesion in coronary arteries.

Cases in grade II, III, IV changes according to age in different coronary arteries and aorta is tabulated in table 1, 2 and 3.

**Table 1:** Grade II atherosclerotic changes in different age groups in different vessels.

Age group	RCA	LCX	LAD	Aorta
0-9	0	0	0	0
10-19	0	0	0	0
20-29	0	0	0	0
30-39	01	01	0	04
40-49	0	0	0	03
50-59	01	0	01	02
60-69	0	0	0	02
70-79	0	0	0	0

**Table 2:** Grade III atherosclerotic changes in different age groups in different vessels.

Age group	RCA	LCX	LAD	Aorta
0-9	0	0	0	0
10-19	0	0	0	0
20-29	0	0	0	03
30-39	0	0	0	0
40-49	02	02	01	01
50-59	0	0	0	01
60-69	0	0	0	0
70-79	0	0	0	0

**Table 3:** Grade IV atherosclerotic changes in different age groups in different vessels.

Age group	RCA	LCX	LAD	Aorta
0-9	0	0	0	0
10-19	0	0	0	0
20-29	0	0	0	0
30-39	0	01	01	01
40-49	0	0	02	01
50-59	01	03	02	01
60-69	0	0	0	0
70-79	0	0	0	0

Severity grading of atherosclerosis in RCA with age showed grade IV changes in only one case, grade III in two cases, grade II in two cases and grade I in three cases. Majority of these cases were in 5th decade.

Severity grading of atherosclerosis in LCX with age showed one case in grade VII, one case in grade VI, four cases in grade IV, two cases in grade III and one case in grade II. Majority of these cases were in 5th decade.

Severity grading of atherosclerosis in LAD with age showed one case in grade V, five cases in grade IV, one case in grade III, one case in grade II and one case in grade I. Majority of these cases were in 5th decade.



Severity grading of atherosclerosis in Aorta with age showed majority of the lesions in grade II<sup>11</sup> followed by five cases in grade III, four cases in grade I and three cases in grade IV. Majority of these cases were seen in 4th decade.

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### DISCUSSION

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Atherosclerosis develops progressively through continuous evolution of arterial wall lesions which have been described in the histopathology of plaques in humans and experimental animals. These changes are closely similar in coronary arteries and aorta which in turn form a strong description of cumulative development of atherosclerosis.<sup>4</sup>

The prevalence of atherosclerotic lesions in our study was 49% which is concordant with study by Khanna K et al and Garg M et al.<sup>6,7</sup> In the present study, majority (77%) of cases were male and 23% were female which is in concordance with studies done by Garg M et al, Thej MJ et al, Vyas P et al, Venkatesh K et al, Abedinzadeh et al and Yazdi et al.<sup>8-11</sup>

Early fatty streak development begins in childhood and adolescence. Atherosclerosis is believed to start when the lipid accumulation appears as confluent extracellular lipid pools and extracellular lipid cores with decreased cellularity. Considering age factor, majority of cases in present study were noted in younger population (3rd and 2nd decade) in concordance with studies done by Yazdi et al, Joseph A et al, Khanna K et al.<sup>12</sup> In few other studies majority of cases were in 3rd and 4th decade. These variations can be explained by diversity of lifestyle, food habits, Socio-economic status and environmental factors.

LAD was the frequently involved coronary artery which was concordant with other studies. Atherosclerotic lesions were noted most commonly in aorta and fatty streak (Grade II) lesions were mostly noted in aorta.

Our study had majority of lesions in grade II followed by grade IV and grade III. Khanna K et al noticed maximum lesions in grade III followed by grade IV. Thej M et al and Khanna K et al did not consider grade I and grade II lesions as atherosclerotic. But grade II lesions appear to be significant as they are occurring at

younger age groups and can evolve into more advanced lesions.

According to a study by Dalager S et al, coronary arteries had the most prevalence of lipid core plaques which were considered vulnerable plaques and hence more deaths resulting from such lesions.<sup>13</sup> Fibrous plaque lesions start forming at about 15-30 years of age and continue throughout life. Atheromatous plaques seem to progress into advanced lesions as the age increases. This feature was noticed in this study and in most of the other studies.

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### CONCLUSION

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The study of atherosclerotic lesions in living subjects is a difficult task. Autopsy study is a cost effective approach and helps in estimating future disease burden in the population. The study had a male preponderance but an increased proportion of females are seen presenting with atherosclerotic lesions. An increased prevalence of atherosclerosis was seen in younger population. This study suggests more screening programs and preventive measures be taken for atherosclerosis at young age.

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