

## Original Research Article

# Atherosclerotic changes in aorta and coronary arteries at autopsy in North Indian population

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## ABSTRACT

**Background:** Cardiovascular disease (CVD) has become a ubiquitous cause of morbidity and a leading contributor to mortality in most countries. It has emerged as a major health burden worldwide with atherosclerosis being the major cause.

**Methods:** 150 random cases of different age groups brought for postmortem examination in the Department of Forensic Medicine PGIMS, Rohtak. Heart was removed and examined after obtaining the consent of next of the kin of the deceased. Gross macroscopic changes were noted and microscopic changes examination was done and reported by preparation of slides in collaboration with Department of Pathology of the Institute.

**Results:** The study group comprised of mostly males (70%) with mean age of  $36.90 \pm 13.88$  years. Almost half of them were in their third and fourth decade of life. 83 cases were found to have atherosclerosis and 25 of them belonged to the age group 40 to 49 years. 82 % of these cases were of male gender. Histopathological grading carried out displayed that Grade III lesions were maximum (27.5%) followed by grade IV lesions (19.0%) and in no section grade VIII lesions were seen.

**Conclusion:** Atherosclerosis has emerged as a new epidemic affecting at a relatively younger age. This study would help in planning of preventive measures directed at the right population. Clinicians could take measures at an early stage to prevent the progression of the disease and will help forensic pathologists in dealing with opinion regarding cause of death.

**Key Words:** Atheroma, Autopsy, Calcification, Fibro-fatty plaques, Occlusion

## INTRODUCTION

Atherosclerosis is defined as thickening of artery wall due to accumulation of fatty materials and is one of the leading cause of ischemic heart disease worldwide and gradually the age of its occurrence have been seen in

younger population. Cardiovascular deaths (CVDs) accounted for around one fourth of all deaths in India in 2008. Age standardized CVD death rates in people 30-69 years old were reported to be 180, 280 and 405 per 100,000 in Britain, China and India respectively.<sup>1</sup> The total years of life lost due to total cardiovascular disease

among the Indian men and women aged 35-64 has been estimated to be higher than comparable countries such as Brazil and China. These estimates are predicted to increase by 2030.<sup>2,3</sup> Wig KL et al, in their study in North India studied 151 hearts for coronary atherosclerosis, found that significant atheroma was present in nearly two-thirds (64%) of those above the age of 20, and, except for the fifth decade, there was a gradual increase in both its frequency and severity from the second to the sixth decade.<sup>4</sup> Golshahi et al, studied 204 autopsy specimens in Isfahan Forensic Medicine Center Iran, atheromatous plaques were observed in 60 (29.4%) of which 57 were male (31.3% of the male population) and 3 were female (13.6% of the female population).<sup>5</sup> Yazdi SA et al, studied hearts of 80 cadavers from 11 to 50 years old with no history of cardiac disease in Iran. They found that about three quarter of the sample had at least one fibro-fatty or advanced plaque in major coronary arteries.<sup>6</sup> As study of atherosclerosis in living population is difficult, invasive and expensive especially in developing countries autopsy studies has been proved to be a good method for assessing atherosclerosis.<sup>7</sup> The aim was to evaluate the prevalence of atherosclerosis, we targeted this study on the hearts of subjects who died of non-cardiac causes. With this background, the aim of the study was to assess the incidence and severity of atherosclerotic changes in different age groups in autopsy subjects.

## **METHODS**

One hundred and fifty random cases of different age groups brought for medico-legal autopsy in the mortuary of the Department of Forensic Medicine Pt. BD Sharma, Post Graduate Institute of Medical Sciences (PGIMS), Rohtak between 2012-2014 were included in the study. Heart was removed and examined after obtaining the written informed consent from next of kin of the deceased.

The study was ethically approved by the Institute's Ethical committee. The Institute's Ethical committee ethically approved the study. Gross macroscopic and microscopic changes were noted.

### ***Inclusion criteria***

- Hearts were obtained only from the identified bodies
- Only intact hearts were included in the study
- All the cases brought for medico-legal autopsy.

### ***Exclusion criteria***

- Unknown/unidentified dead bodies
- Cases showing signs of decomposition or completely charred bodies
- Ruptured heart, myocardial fibrosis, adhesions cardiac aneurysm, cardiac tamponade.

## ***Procedure***

The thorax and the abdomen were opened by making an I-shaped incision extending from chin straight down to symphysis pubis passing either to left or the right of umbilicus. Pericardium was opened and examined for any adhesions between its two surfaces or if there is any abnormal quantity of fluid present in its cavity. The heart was examined in situ for any abnormalities including condition of its chambers, musculature, position of the vessels, any injury or rupture etc. Then the heart fulfilling the inclusion criteria of the study was removed from the body. The hearts thus removed from the body was weighed and then preserved in a jar with 10% formalin and further examination was carried out after fixation.

First gross examination of the heart, aorta and the coronary arteries was done. Heart was examined for the presence of any valvular disease, the condition of the endocardium, myocardium and evidence of any infarct or fibrosis etc. Aorta was examined for the thickening of wall, presence and nature of atheromatous lesions including fatty streaks, the presence and degree of calcification. The coronary arteries namely, Left Main Stem (LMCA), Left Anterior Descending (LAD), Left Circumflex (LCx) and the Right Coronary Artery (RCA) were examined for the thickening of their walls. For doing all these both the anterior and posterior surfaces were grossly examined. The aorta is a curved shaped structure near the right atrium whose section was taken near the fatty streak or fibrous plaque or any calcification if present. The left auricle is lifted and cuts are made in the LMCA and the LAD branch of it to look for the atherosclerotic plaque or the thrombus. The coronary arteries were cross-sectioned at 5-mm intervals from the ostia to the terminal pericardial branches to determine the presence or absence of atherosclerotic plaques and any lumen narrowing and sections were placed in a histology cassette.

After routine processing and paraffin embedding, 4 µm sections were taken and stained with Hematoxylin-Eosin. All the histological sections were examined microscopically for the presence of atheroma and American Heart Association typing of atherosclerotic plaque was done.

### ***Microscopic examination of aorta and coronaries***

The aorta was examined for fatty streaks, fibrous plaques, complicated or uncomplicated lesions. In coronary arteries, the lesions of atherosclerosis were evaluated in two parameters pertaining to:-degree of occlusion and plaque.

### ***Degree of occlusion***

- Grade 0: No change on gross and microscopic examination

- Grade I: Artery appearing grossly normal but having microscopic findings of atherosclerosis.
- Grade II: Thickening of vessel wall with 25 to 50% narrowing of lumen.
- Grade III: Thickening of vessel wall with 50 to 75% narrowing of lumen.
- Grade IV: Thickening and calcification with more than 75% narrowing of lumen.

In our study, grade III and grade IV lesions were considered significant.

### Plaque

American Heart Association typing of atherosclerotic plaque was done as under

- Grade 0 - No change
- Grade 1 - isolated intimal foamy cells (minimal change)
- Grade 2 - numerous intimal foamy cells often in layers (fatty streaks)
- Grade 3 - pools of extra cellular lipid without a well-defined core (intermediate lesion or pre-atheroma)
- Grade 4 - well defined lipid core with luminal surface covered by normal intima (atheromas or fibro plaque)
- Grade 5 - lipid core with a fibrous cap with or without calcification (fibro- atheroma)
- Grade 6 - fibro-atheroma with cap defect such as haemorrhage and thrombosis
- Grade 7 - calcification prominent
- Grade 8 - fibrous tissue change prominent

In our study we had considered grade IV to grade VIII lesions as significant.

For Statistical Evaluation, SPSS statistical software version 20.0 was applied and the results were analyzed using simple proportion and percentages and Chi-Square was used to test the significance.

## RESULTS

Out of one hundred and fifty cases included in the study, majority of the cases were of the 3rd decade of life (26%) followed by 4th decade (20%) and 5th decade (18.7%) as shown in Figure 1.

Among the cases selected as per the inclusion criteria, the predominant cause of death was Road Traffic Accident (RTA) in 61/150, 40.7% cases, followed by suicidal poisoning and burns in 50 (36.7%) and 20 (13.3%) cases respectively.

Severity grading of atherosclerosis in LMCA with age showed absence of grade IV severity at any age. Only 7 subjects had Grade III changes with 3 subjects each in fourth and fifth decade. About half of the subject

population (54%) had Grade I severity with subjects majorly falling in fourth, fifth and sixth decade as shown in table 1A.

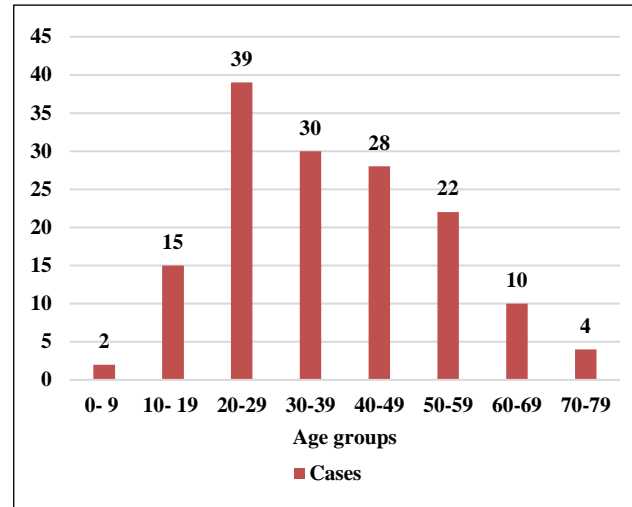


Figure 1: Age wise distribution of cases.

Severity grading of atherosclerosis in LAD with age showed presence of grade IV severity in about 2% of 8<sup>th</sup> decade subjects. Fifty seven subjects (38%) had Grade III severity majorly belonging to fifth and sixth decade. Almost a quarter had no atherosclerotic changes as shown in Table 1B.

Severity grading of atherosclerosis in LCx with age showed absence of grade IV severity at any age. About half of the subjects had Grade I changes with equal number of subjects (20) affected in fourth and fifth decade respectively as shown in Table 1C.

Severity grading of atherosclerosis in RCA with age showed grade IV severity in older patients belonging to eighth decade. Atherosclerosis was absent in about 35 subjects while grade I severity was noticed in 69 subjects as shown in Table 1D.

Severity in coronary arteries namely, LMCA, LAD, LCx and RCA on the basis of occlusion has maximum Grade I lesions (42.8%) whereas 1.3% cases (minimum in number) had grade IV lesions; atherosclerosis with more than 50% narrowing i.e grade III and grade IV lesions were seen in 20.3% cases as shown in Table 2. About 39.3% cases in Left Main Stem Coronary Artery (LMCA) were free of atherosclerosis considering the AHA classification. Maximum number of cases with atherosclerotic changes were from grade III 43(28.7%) and in 6.0% of cases grade IV was present as shown in Table 3A.

Left Anterior Descending (LAD) as per AHA classification had 23.3% cases free of atherosclerosis. Maximum number of cases with atherosclerotic changes were from grade IV 50 (33.3%) as shown in Table 3B.

No changes (Grade 0) were noticed in 39.3% cases in Left Circumflex Artery (LCx) considering the AHA

classification. Grade III lesions seen in 22.7% and 12.0% cases had grade IV as shown in Table 3C.

**Table 1A: Severity of Atherosclerosis in Left Main Stem Coronary Artery (LMCA) on the basis of grades of occlusion with age wise distribution.**

Age group (in years)	Atherosclerosis Absent	Frequency of involvement (n)				
	Grade 0	Severity of atherosclerosis (occlusion)				
	Grade 0	Grade I	Grade II	Grade III	Grade IV	Total
0-9	2(1.3%)	0(0.0%)	0(0.0%)	0(0.0%)	0(0.0%)	2(1.3%)
10-19	15(10.0%)	0(0.0%)	0(0.0%)	0(0.0%)	0(0.0%)	15(10.0%)
20-29	28(18.7%)	11(7.3%)	0(0.0%)	0(0.0%)	0(0.0%)	39(26.0%)
30-39	8(5.3%)	18(12.0%)	1(0.7%)	3(2.0%)	0(0.0%)	30(20.0%)
40-49	5(3.3%)	20(13.3%)	0(0.0%)	3(2.0%)	0(0.0%)	28(18.7%)
50-59	1(0.7%)	19(12.7%)	1(0.7%)	1(0.7%)	0(0.0%)	22(14.7%)
60-69	0(0.0%)	9(6.0%)	1(0.7%)	0(0.0%)	0(0.0%)	10(6.7%)
70-79	0(0.0%)	4(2.7%)	0(0.0%)	0(0.0%)	0(0.0%)	4(2.7%)
Total	59(39.3%)	81(54.0%)	3(2.0%)	7(4.7%)	0(0.0%)	150(100.0%)

**Table 1B: Severity of Atherosclerosis in Left Anterior Descending (LAD) on the basis of grades of occlusion with age wise distribution.**

Age group (in years)	Atherosclerosis Absent	Frequency of involvement (n)				
	Grade 0	Severity of atherosclerosis (occlusion)				
	Grade 0	Grade I	Grade II	Grade III	Grade IV	Total
0-9	2(1.3%)	0(0.0%)	0(0.0%)	0(0.0%)	0(0.0%)	2(1.3%)
10-19	14(9.3%)	1(0.7%)	0(0.0%)	0(0.0%)	0(0.0%)	15(10.0%)
20-29	17(11.3%)	13(8.7%)	0(0.0%)	9(6.0%)	0(0.0%)	39(26.0%)
30-39	2(1.3%)	9(6.0%)	7(4.7%)	12(8.0%)	0(0.0%)	30(20.0%)
40-49	0(0.0%)	6(4.0%)	9(6.0%)	13(8.7%)	0(0.0%)	28(18.7%)
50-59	0(0.0%)	4(2.7%)	2(1.3%)	15(10.0%)	1(0.7%)	22(14.7%)
60-69	0(0.0%)	1(0.7%)	1(0.7%)	7(4.7%)	1(0.7%)	10(6.7%)
70-79	0(0.0%)	0(0.0%)	0(0.0%)	1(0.7%)	3(2.0%)	4(2.7%)
Total	35(23.3%)	34(22.7%)	19(12.7%)	57(38.0%)	5(3.3%)	150(100.0%)

**Table 1C: Severity of Atherosclerosis in Left Circumflex Artery (LCx) on the basis of grades of occlusion with age wise distribution.**

Age group (in years)	Atherosclerosis Absent	Frequency of involvement (n)				
	Grade 0	Severity of atherosclerosis (occlusion)				
	Grade 0	Grade I	Grade II	Grade III	Grade IV	Total
0-9	2(1.3%)	0(0.0%)	0(0.0%)	0(0.0%)	0(0.0%)	2(1.3%)
10-19	15(10.0%)	0(0.0%)	0(0.0%)	0(0.0%)	0(0.0%)	15(10.0%)
20-29	31(20.7%)	8(5.3%)	0(0.0%)	0(0.0%)	0(0.0%)	39(26.0%)
30-39	7(4.7%)	20(13.3%)	0(0.0%)	3(2.0%)	0(0.0%)	30(20.0%)
Age group (in years)	Atherosclerosis Absent	Frequency of involvement (n)				
	Grade 0	Severity of atherosclerosis (occlusion)				
	Grade 0	Grade I	Grade II	Grade III	Grade IV	Total
40-49	3(2.0%)	20(13.3%)	0(0.0%)	5(3.3%)	0(0.0%)	28(18.7%)
50-59	1(0.7%)	17(11.3%)	2(1.3%)	2(1.3%)	0(0.0%)	22(14.7%)
60-69	0(0.0%)	6(4.0%)	2(1.3%)	2(1.3%)	0(0.0%)	10(6.7%)
70-79	0(0.0%)	2(1.3%)	0(0.0%)	2(1.3%)	0(0.0%)	4(2.7%)
Total	59(39.3%)	73(48.7%)	4(2.7%)	14(9.3%)	0(0.0%)	150(100.0%)

**Table 1D: Severity of Atherosclerosis in right coronary artery on the basis of grades of occlusion with age wise distribution.**

Age group (in years)	Atherosclerosis Absent	Frequency of involvement (n)				
		Severity of atherosclerosis (occlusion)				
	Grade 0	Grade I	Grade II	Grade III	Grade IV	Total
0-9	2(1.3%)	0(0.0%)	0(0.0%)	0(0.0%)	0(0.0%)	2(1.3%)
10-19	14(9.3%)	1(0.7%)	0(0.0%)	0(0.0%)	0(0.0%)	15(10.0%)
20-29	16(10.7%)	21(14.0%)	0(0.0%)	2(1.3%)	0(0.0%)	39(26.0%)
30-39	2(1.3%)	23(15.3%)	1(0.7%)	4(2.7%)	0(0.0%)	30(20.0%)
40-49	1(0.7%)	19(12.7%)	0(0.0%)	8(5.3%)	0(0.0%)	28(18.7%)
50-59	0(0.0%)	5(3.3%)	2(1.3%)	14(9.3%)	1(0.7%)	22(14.7%)
60-69	0(0.0%)	0(0.0%)	3(2.0%)	7(4.7%)	0(0.0%)	10(6.7%)
70-79	0(0.0%)	0(0.0%)	0(0.0%)	2(1.3%)	2(1.3%)	4(2.7%)
Total	35(23.3%)	69(46.0%)	6(4.0%)	37(24.7%)	3(2.0%)	150(100.0%)

**Table 2: severity grading in all four coronary arteries (LMCA, LAD, LCX and RCA) on the basis of grades of occlusion.**

Artery involved	Atherosclerosis Absent	Frequency of involvement (n)			
		Severity of atherosclerosis (occlusion)			
	Grade 0	Grade I	Grade II	Grade III	Grade IV
LMCA	59(39.3%)	81(54.0%)	3(2.0%)	7(4.7%)	0(0.0%)
LAD	35(23.3%)	34(22.7%)	19(12.7%)	57(38.0%)	5(3.3%)
LCx	59(39.3%)	73(48.7%)	4(2.7%)	14(9.3%)	0(0.0%)
RCA	35(23.3%)	69(46.0%)	6(4.0%)	37(24.7%)	3(2.0%)
Total	188(31.3%)	257(42.8%)	32(5.3%)	115(19.2%)	8(1.3%)

**Table 3A: Severity grading of atherosclerosis in left main stem artery (LMCA) on the basis of atherosclerotic plaque with age wise distribution.**

Age group (in years)	Frequency of involvement (n)									
	Grading of atherosclerosis (Plaque)									
	Grade 0	Grade I	Grade II	Grade III	Grade IV	Grade V	Grade VI	Grade VII	Grade VIII	Total
0-9	2 (1.3%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	2 (1.3%)
10-19	15 (10.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	15 (10.0%)
20-29	28 (18.7%)	0 (0.0%)	8 (5.3%)	3 (2.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	39 (26.0%)
30-39	8 (5.3%)	3 (2.0%)	7 (4.7%)	9 (6.0%)	3 (2.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	30 (20.0%)
40-49	5 (3.3%)	2 (1.3%)	9 (6.0%)	9 (6.0%)	3 (2.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	28 (18.7%)
Age group (in years)	Frequency of involvement (n)									
	Grading of atherosclerosis (Plaque)									
	Grade 0	Grade I	Grade II	Grade III	Grade IV	Grade V	Grade VI	Grade VII	Grade VIII	Total
50-59	1 (0.7%)	1 (0.7%)	3 (2.0%)	15 (10.0%)	2 (1.3%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	22 (14.7%)
60-69	0 (0.0%)	0 (0.0%)	4 (2.7%)	5 (3.3%)	1 (0.7%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	10 (6.7%)
70-79	0 (0.0%)	0 (0.0%)	2 (1.3%)	2 (1.3%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	4 (2.7%)
Total	59 (39.3%)	6 (4.0%)	33 (22.0%)	43 (28.7%)	9 (6.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	150 (100.0%)

**Table 3B: Severity grading of Atherosclerosis in Left Anterior Descending (LAD) on the basis of atherosclerotic plaque with age wise distribution.**

Age group (in years)	Frequency of involvement (n)									
	Grading of atherosclerosis (Plaque)									
	Grade 0	Grade I	Grade II	Grade III	Grade IV	Grade V	Grade VI	Grade VII	Grade VIII	Total
0-9	2 (1.3%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	2 (1.3%)
10-19	14 (9.3%)	0 (0.0%)	1 (0.7%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	15 (10.0%)
20-29	17 (11.3%)	2 (1.3%)	4 (2.7%)	7 (4.7%)	9 (6.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	39 (26.0%)
30-39	2 (1.3%)	0 (0.0%)	2 (1.3%)	11 (7.3%)	14 (9.3%)	1 (0.7%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	30 (20.0%)
40-49	0 (0.0%)	0 (0.0%)	0 (0.0%)	7 (4.7%)	18 (12.0%)	3 (2.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	28 (18.7%)
50-59	0 (0.0%)	0 (0.0%)	0 (0.0%)	5 (3.3%)	6 (4.0%)	8 (5.3%)	0 (0.0%)	3 (2.0%)	0 (0.0%)	22 (14.7%)
60-69	0 (0.0%)	0 (0.0%)	0 (0.0%)	1 (0.7%)	2 (1.3%)	2 (1.3%)	3 (2.0%)	2 (1.3%)	0 (0.0%)	10 (6.7%)
70-79	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	1 (0.7%)	1 (0.7%)	1 (0.7%)	1 (0.7%)	0 (0.0%)	4 (2.7%)
Total	35 (23.3%)	2 (1.3%)	7 (4.7%)	31 (20.7%)	50 (33.3%)	15 (10.0%)	4 (2.7%)	6 (4.0%)	0 (0.0%)	150 (100.0%)

**Table 3C: Severity grading of atherosclerosis in left circumflex artery (LCX) on the basis of atherosclerotic plaque with age wise distribution.**

Age group (in years)	Frequency of involvement (n)									
	Grading of atherosclerosis (Plaque)									
	Grade 0	Grade I	Grade II	Grade III	Grade IV	Grade V	Grade VI	Grade VII	Grade VIII	Total
0-9	2 (1.3%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	2 (1.3%)
10-19	15 (10.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	15 (10.0%)
20-29	31 (20.7%)	2 (1.3%)	5 (3.3%)	1 (0.7%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	39 (26.0%)
30-39	7 (4.7%)	1 (0.7%)	11 (7.3%)	8 (5.3%)	3 (2.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	30 (20.0%)
40-49	3 (2.0%)	0 (0.0%)	14 (9.3%)	6 (4.0%)	5 (3.3%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	28 (18.7%)
50-59	1 (0.7%)	0 (0.0%)	4 (2.7%)	13 (8.7%)	4 (2.7%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	22 (14.7%)
Age group (in years)	Frequency of involvement (n)									
	Grading of atherosclerosis (Plaque)									
	Grade 0	Grade I	Grade II	Grade III	Grade IV	Grade V	Grade VI	Grade VII	Grade VIII	Total
60-69	0 (0.0%)	0 (0.0%)	1 (0.7%)	5 (3.3%)	4 (2.7%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	10 (6.7%)
70-79	0 (0.0%)	0 (0.0%)	1 (0.7%)	1 (0.7%)	2 (1.3%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	4 (2.7%)
Total	59 (39.3%)	3 (2.0%)	36 (24.0%)	34 (22.7%)	18 (12.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	150 (100.0%)

About 23.3% cases in Right Coronary Artery (RCA) were free of atherosclerosis considering the AHA

classification mainly seen in second and third decade. 38.0% cases had grade III and in 24.7% cases grade IV was present as shown in Table 3D.



**Table 3D: Severity grading of Atherosclerosis in Right Coronary Artery (RCA) on the basis of atherosclerotic plaque with age wise distribution.**

Age group (in years)	Frequency of involvement (n)									
	Grading of atherosclerosis (Plaque)									
	Grade 0	Grade I	Grade II	Grade III	Grade IV	Grade V	Grade VI	Grade VII	Grade VIII	Total
0-9	2 (1.3%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	2 (1.3%)
10-19	14 (9.3%)	0 (0.0%)	1 (0.7%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	15 (10.0%)
20-29	16 (10.7%)	1 (0.7%)	6 (4.0%)	14 (9.3%)	2 (1.3%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	39 (26.0%)
30-39	2 (1.3%)	1 (0.7%)	4 (2.7%)	19 (12.7%)	3 (2.0%)	1 (0.7%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	30 (20.0%)
40-49	1 (0.7%)	0 (0.0%)	2 (1.3%)	17 (11.3%)	8 (5.3%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	28 (18.7%)
50-59	0 (0.0%)	0 (0.0%)	1 (0.7%)	5 (3.3%)	13 (8.7%)	2 (1.3%)	0 (0.0%)	1 (0.7%)	0 (0.0%)	22 (14.7%)
60-69	0 (0.0%)	0 (0.0%)	0 (0.0%)	2 (1.3%)	8 (5.3%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	10 (6.7%)
70-79	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	3 (2.0%)	1 (0.7%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	4 (2.7%)
Total	35 (23.3%)	2 (1.3%)	14 (9.3%)	57 (38.0%)	37 (24.7%)	4 (2.7%)	0 (0.0%)	1 (0.7%)	0 (0.0%)	150 (100.0%)

**Table 4: Severity grading in all four coronary arteries (LMCA, LAD, LCX and RCA) on the basis of atherosclerotic plaque.**

Artery involved	Severity of atherosclerosis (Plaque)									
	Grade 0	Grade I	Grade II	Grade III	Grade IV	Grade V	Grade VI	Grade VII	Grade VIII	
LMCA	59 (39.3%)	6 (4.0%)	33 (22.0%)	43 (28.7%)	9 (6.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	
LAD	35 (23.3%)	2 (1.3%)	7 (4.7%)	31 (20.7%)	50 (33.3%)	15 (10.0%)	4 (2.7%)	6 (4.0%)	0 (0.0%)	
LCx	59 (39.3%)	3 (2.0%)	36 (24.0%)	34 (22.7%)	18 (12.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	
RCA	35 (23.3%)	2 (1.3%)	14 (9.3%)	57 (38.0%)	37 (24.7%)	4 (2.7%)	0 (0.0%)	1 (0.7%)	0 (0.0%)	
Total	188 (31.3%)	13 (2.2%)	90 (15.0%)	165 (27.5%)	114 (19.0%)	19 (3.2%)	4 (0.7%)	7 (1.2%)	0 (0.0%)	

**Table 5: Correlation of age with order of incidence of atherosclerosis.**

Age group (in years)	Atherosclerosis Present (Ath)			
	Cases with atherosclerosis (Ath)	% within age group	% out of total cases	Total no. of cases
0-9	0	0.0%	0.0%	2(1.3%)
10-19	0	0.0%	0.0%	15(10.0%)
20-29	11	28.2%	7.3%	39(26.0%)
30-39	17	56.7%	11.3%	30(20.0%)
40-49	25	89.3%	16.7%	28(18.7%)
50-59	17	77.3%	11.3%	22(14.7%)
60-69	9	90%	6.0%	10(6.7%)
70-79	4	100%	2.7%	4(2.7%)
Total	83	55.3%	55.3%	150(100.0%)

In all four coronary arteries namely, LMCA, LAD, LCx and RCA when characterized on the basis of AHA classification, it was observed that Grade III lesions were maximum (27.5%) and grade IV were seen in 19.0% cases and in no section there were grade VIII lesions as shown in Table 4. The order of incidence of atherosclerosis is increasing from 0% in 1<sup>st</sup> decade to 100% as the age advances up to 8<sup>th</sup> decade with a steep rise in the 5<sup>th</sup> decade as compared to the 4<sup>th</sup> decade from 56.7% to 89.3% as shown in Table 5.

## DISCUSSION

Present study was an attempt to assess the incidence as well as severity of atherosclerosis in our population. In our study incidence was observed in 55.3%, which corresponds with studies by Garg et al, Virmani et al, Thej et al, but Puri et al, had 86% incidence which was quiet higher but they had considered grade I and grade II lesions of degree of occlusion also as atherosclerotic.<sup>8</sup> The frequencies of these lesions were reported between 16% to 86%.<sup>9,11</sup> The reasons for this diversity can be the variability of race, culture, dietary habits, different socio-economic status and age of the studied samples.

Formation of atherosclerotic lesions starts from early ages, well before its complications are identified. The disease once developed cannot be reverted to normal and can only be made stagnant. Fatty streaks are present in the aorta of most children >3 years old, increasing rapidly in adolescence, with coronary artery involvement beginning about a decade later.<sup>12,13</sup> In our study with increasing age, the order of incidence of atherosclerosis is increasing from 0% in 1<sup>st</sup> decade to 100% as the age advances up to 8<sup>th</sup> decade with a steep rise in the 5<sup>th</sup> decade as compared to the 4<sup>th</sup> decade from 56.7% to 89.3%, although incidence is in increasing order. The increase in relative frequency of the atheromatous plaques with age is expected as atherosclerosis starts at young age and progresses with age also seen in the similar studies.<sup>5,6,8,11</sup>

Findings of significant atherosclerosis with more than 50% narrowing (grade III and IV) were seen in 20.5% cases of our study which were identical to earlier studies like Joseph et al, Singh et al.<sup>14,15</sup> Visual estimation of lesions noted at the time of autopsy was often inaccurate when compared with subsequent microscopic examination. Although the more severe lesions were often close to actual values, assessment of less severe lesions was frequently underestimated. On the basis of plaque formation in coronary arteries namely LMCA, LAD, LCx and RCA, Grade III lesions (pre-atheroma) were maximum (27.5%) and grade IV (atheroma) lesions in 19.0% cases which were also observed by Garg et al.<sup>8</sup> Our study showed atherosclerotic changes maximum in the LAD and least in the LMCA which was comparable with other studies.<sup>6,10,16</sup> Atherosclerotic involvement was ascertained with regard to number of vessels in our study and found Single vessel disease more than double and

triple Vessel Disease as seen in other studies.<sup>11,17</sup> Increasing incidence of atherosclerosis as well as shift towards younger population was noticed in our studies which is now reflected in similar other studies. This was a small sample size study hence cannot be generalized to the whole population and warrants large possibly multi-centric studies along with role of environmental influences.

## CONCLUSION

Atherosclerosis has emerged as a new epidemic affecting relatively younger population. This study would help clinicians to take measures at an early stage to prevent the progression of the disease and help forensic pathologists in dealing with opinion regarding cause of death.

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