A post-mortem study of coronary atherosclerosis and relationship to myocardial infarction in Ajmer region

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ABSTRACT

Background: The incidence of coronary heart disease has markedly increased in India over the past few years. Ischemic heart disease, the largest cause of morbidity and mortality in the developed and developing countries today, is overwhelmingly contributed by atherosclerosis. **Objectives:** The study was done to determine the burden of atherosclerotic lesions in the population of Ajmer district. This study also highlights the various grades of atherosclerotic lesions in coronary arteries and the relationship of atherosclerosis with myocardial infarction (MI). **Materials and Methods:** We studied atherosclerotic lesions in coronary arteries in cases subjected to autopsy in last 5 years, to grade and to evaluate the atheromatous plaques; and to assess the cases of MI among them. The study comprises dissected specimens of heart in total 600 cases subjected for an autopsy. The vessels were examined for the presence of atherosclerotic lesions which were graded according to the American Heart Association and examined for evidence of MI. **Results:** The study comprises the cases in the age group between 0 to 80 years. The most common type of atherosclerosis seen was Grade 5. Left anterior descending coronary was most commonly involved artery. MI was the cause of death in 75 cases (12.5%). The data obtained may form a baseline for the forthcoming studies. **Conclusion:** This study highlights the importance of cardiovascular risk factors screening from early ages of third decades. Our study aids valuable data to the literature regarding the morphology of atherosclerotic lesions.

KEY WORDS: Atherosclerosis; Autopsy; Coronary Plaque; Infarction

INTRODUCTION

Coronary artery disease (CAD) is a multifactorial disease usually affecting people in "middle age." According to the World Heart Federation, 35% of all deaths caused by cardiovascular disease in India occur in those aged 35-64 years.[1]

CAD due to atherosclerosis is an epidemic in India. The incidence of CAD has doubled during the past three to four decades. It will soon emerge as the single largest disease accounting for nearly one-third of all deaths in India. A total of nearly 6.4 crore cases of the coronary vascular disease are likely in the year 2015; nearly 96% would be coronary heart disease cases. Deaths from this group of diseases are likely to amount to be a staggering 34 lakh. An estimated 1.3 million Indians died from this in 2000. The projected death from CAD by 2015 is 2.95 million, of which 14% will be <30 years, 31% will be <40 years.[2]

Epidemiological studies performed in last 50 years have revealed that there is a significant rise in the prevalence of CAD in urban as well as in rural Indian population and CAD has been predicted to assume epidemic proportions in India by the year 2015.[3]

Major advances in medical, interventional, and surgical therapy, together with effective secondary prevention, have

resulted in extended life expectancy and an improvement in the quality of life of most patients with clinical CAD. Despite these achievements, the prevalence of CAD seems to remain high. However, the exact data on the prevalence of coronary atherosclerosis or clinical CAD s are extremely diverse.[4]

The present study primarily describes the extent, severity, and frequency of coronary atherosclerosis in the Ajmer region and compares the findings with other population groups and secondarily describes the frequency of ischemic heart disease. As an autopsy study gives a good measure of the prevalence, grading, and distribution pattern of atherosclerotic lesions and its correlation with risk factors. To assess the magnitude of the problem, a retrospective study of autopsied patients for the presence of coronaries artery diseases was undertaken.

MATERIALS AND METHODS

In the present study, heart specimens of 600 consecutive post-mortem cases, received in the pathology section of the JLN Medical College, Ajmer, were examined grossly and microscopically for the presence and extent of atherosclerosis and evidence of myocardial infarction (MI). Few specimens underwent autolysis before the examination. The heart was fixed in 10% formalin, weighed, and then investigated for the presence of scars of MI. Measurements of the right ventricular wall, left ventricular wall, interventricular septa, and stump of aorta were taken. Circumferences of the mitral, tricuspid, pulmonary, and aortic valve were noted. The three main coronary arteries were dissected out. Each coronary artery was then sectioned by multiple closely spaced cuts with a scalpel. The exposed artery was carefully examined for any thickening, yellow streaks, frank plaque, or calcification. Then, ventricles were sectioned transversely at 10 mm intervals commencing from the apex. After routine processing and paraffin embedding, 4 μm sections were taken.

All the histological sections were examined microscopically for the presence of atheroma and MI. The American Heart Association typing of atherosclerotic plaque was done. The American Heart Association criteria for grading atherosclerotic lesions were as follows: [5,6]
- Grade 1 - Isolated intimal foamy cells(minimal change)
- Grade 2 - Numerous intimal foamy cells often in layers (fatty streaks)
- Grade 3 - Pools of extracellular lipid without a well-defined core (intermediate lesion or pre-atheroma)
- Grade 4 – Well-defined lipid core with luminal surface covered by normal intima (atheroma or fibro plaque)
- Grade 5 - Lipid core with a fibrous cap with or without calcification (fibro-atheroma)
- Grade 6 - Fibroatheroma with cap defects such as hemorrhage and thrombosis
- Grade 7 - Calcification prominent
- Grade 8 - Fibrous tissue change prominent.

RESULTS

A total of 600 post-mortem hearts were studied. The heart was examined grossly as well microscopically for the presence of coronary atherosclerosis and then graded for morphological type according to the American Heart Association. The study comprised cases age ranging from 0 to 80 years. The average weight of the heart in the study was 297.45 g. A total number of cases are 600. 467 (77.8%) cases were male and 133 (22.8%) were female.

Of 600 cases, 312 (52%) cases showed the changes of atherosclerosis. The maximum number of atherosclerosis changes was found in the fifth decade. The least number of cases was found in the eighth decade (Table 1). Of total 467 males, 264 (56.5%) males showed changes of atherosclerosis. Females were positive in 48 (36.1%) out of total 133 females. The youngest male in the study was 16 years old while female was 15 years old. The oldest female was 75 years old while the male was 80 years old. M: F ratio is 5.5:1.

The most common grade found in this study is Grade 5 which made maximum number of cases of total positive cases. Of total 264 positive males, 59 (22.3%) cases were from Grade 5. Minimum number of cases was from Grade 1 which made 10 (3.8%) cases of total cases (Table 2).

The most common artery involved in atherosclerosis is left anterior descending (60.9%), followed by left circumflex artery (47.4%), and least involved is right coronary involved in 30.4% of total cases.

The maximum number of atherosclerosis cases involved triple vessels (42.3%), followed by the double-vessel involved cases (35.9%) and least involved cases were of single-vessel type (Table 3).

Of total 600 cases, 75 cases showed the changes of ischemia and MI made 12.5% of total cases. Of 75 cases of MI, 68 (90.7%) were male and 07 (9.3%) were female.

Table 1: Age-wise distribution of coronary atherosclerosis cases in the present study

Age group (years)	Atherosclerotic changes		
	Present (%)	Absent (%)	Total
0-10	0 (0)	8 (100)	8
11-20	11 (25.6)	32 (74.4)	43
21-30	42 (30.4)	96 (69.6)	138
31-40	76 (48.1)	82 (51.9)	158
41-50	80 (67.8)	38 (32.2)	118
51-60	63 (74.1)	22 (25.9)	85
61-70	31 (77.5)	9 (22.5)	40
71-80	9 (90.0)	1 (10.0)	10
Total	312 (52.0)	288 (48.0)	600

The maximum number of MI cases was found in the sixth decade, i.e., 20 out of 75 cases made 26.7% of total MI cases (Table 4).

DISCUSSION

The present study was conducted in Ajmer region of Rajasthan for 5 years. A total of 600 post-mortem hearts were studied. Of 600 cases, 467 (77.8%) cases were male and 133 (22.8%) were female. 312 (52%) showed the change of atherosclerosis. The most common grade found in this study is Grade 5 which made maximum number of cases (64 cases) of total positive cases. The most common artery involved in atherosclerosis is left anterior descending, followed by left circumflex artery, and least involved is right coronary. The maximum number of atherosclerosis cases involved triple vessels, followed by the double-vessel involved cases, and least involved cases were of single-vessel type. Of total 600 cases, 75 cases showed the changes of ischemia and MI.

Table 2: Grading of atherosclerosis correlated with age in the present study

Age group (years)	Grade 1	Grade 2	Grade 3	Grade 4	Grade 5	Grade 6	Grade 7	Total
0–10	0	0	0	0	0	0	0	0
11–20	1	4	6	0	0	0	0	11
21–30	5	3	19	7	2	4	2	42
31–40	2	11	14	14	21	7	7	76
41–50	1	7	7	18	18	17	12	80
51–60	1	3	4	13	18	11	13	63
61–70	1	3	0	4	4	10	9	31
71–80	0	0	0	2	1	3	3	9
Total (%)	11 (3.5)	31 (9.9)	50 (16.0)	58 (18.6)	64 (20.5)	52 (16.7)	46 (14.7)	312 (100)

Table 3: Number of vessels involved in atherosclerotic cases

Age group (years)	Total cases	Number (%)		
		Single-vessel involved	Two-vessel involved	Triple-vessel involved
0–10	00	0 (0)	0 (0)	0 (0)
11–20	11	4 (1.3)	4 (1.3)	3 (1.0)
21–30	42	12 (3.8)	9 (2.9)	21 (6.7)
31–40	76	19 (6.1)	31 (9.9)	26 (8.3)
41–50	80	13 (4.2)	33 (10.6)	34 (10.9)
51–60	63	14 (4.5)	21 (6.7)	28 (9.0)
61–70	31	4 (1.3)	10 (3.2)	17 (5.4)
71–80	09	2 (0.6)	4 (1.3)	3 (1.0)
Total	312	68 (21.8)	112 (35.9)	132 (42.3)

Table 4: Relation of atherosclerosis with MI

Age groups (years)	Total cases	MI cases			Single-vessel involvement	Double-vessel involvement	Triple-vessel involvement
		Male	Female	Total			
				N (%)			
0–10	8	0	0	0 (0)	0	0	0
11–20	43	0	0	0 (0)	0	0	0
21–30	138	13	2	15 (10.9)	6	2	7
31–40	158	15	2	17 (10.8)	2	8	7
41–50	118	18	2	20 (16.9)	1	4	15
51–60	85	16	1	17 (20.0)	1	3	13
61–70	40	5	0	5 (12.5)	0	2	3
71–80	10	1	0	1 (10)	0	0	1
Total	600	68	7	75 (12.5)	10	19	46

MI: Myocardial infarction

In the present study, it was observed that 467 cases (77.8%) were male and 133 (22.2%) were female which are more or less similar to most of the studies done in the past. Keche et al.[7] studied 120 cases, of which 90 (75%) were male and 30 (25%) were female. Shiladaria et al.[8] studied 300 cases with 216 (72%) males and 84 (28%) females. Similarly, Bhargava and Bhargava[9] studied 74.8% males and 24.2% females in their study. The reason is that males are bread earners and females usually doing household work, which makes the males more vulnerable to accidents, violence, and stress. Furthermore, males more indulge themselves in smoking; alcoholism, etc. Average heart weight in our study was 297.45 grams which was low as compared to the 327 g by Bertomeu et al.[5]

The American Heart Association characterized and classified atherosclerotic lesions from Grade 1 to Grade 8. It was proposed that these lesions progressed from one type to the next. The fibroatheroma type (Grade 5) was the most common type in our study (20.5%), next in frequency was atheroma (18.6%); however, Dhruva et al.[10] found Grade 4 (27.4%) and Garg et al.[11] found Grade 3 (30.9%) as most common type. Atherosclerotic lesions develop very early in life starting from age 15 years onward. The overall incidence of atherosclerosis was found to be 52% which was comparable with the frequency given by Yazdi et al. (40%)[12] and Mcgill et al. (58%).[13] The degree of atheroma encountered in different age group and in two sexes. Significant atheroma appeared in the second decade onward (25.6%), and thereafter, there is a gradual increase both in its severity and frequency from the third decade onward. Maximum incidence was in the eighth decade (90%). Earlier studies in India by Wig et al.[14] found significant atheroma in two-third of cases above the age of 20 years while Tandon et al.[15] found atherosclerosis in the second and third decades. Singh[16] found atherosclerosis at the age of 17 years. Thereafter, there was a steep rise in all the studies. Syed et al. observed that after the second-decade, atherosclerosis suddenly increases, and under 20 years, rarely advanced plaques were existed. Although we cannot explain the reason for a sudden increase after the second decade, it deserves to attract enough attention. The incidence of coronary involvement in left anterior descending was 60.9%, right coronary artery 30.4%, and left circumflex artery 47.4%. This was in concordance with the data given by Sudha et al.[17] who showed left anterior descending as the most common site for plaque (47%) and Yazdi et al.[12] who showed left anterior descending as the most commonly involved artery (60%). Single-vessel involvement was seen in 21.8% while two-vessel and three-vessel involvements were seen in 35.9% and 42.3% cases. Three-vessel involvement was the most common in our study. It was correlated with the study given by Yazdi et al.,[12] but Virmani et al.[18] showed single-vessel disease was greater than others (44%). Acute MI was seen in 75 cases (12.5%) comparable with the data given by Maru (6.5%).[19] The contribution of hypertension, serum cholesterol, and cigarette smoking could not be assessed.

The present study showed unexpectedly high prevalence of atherosclerosis in India. Although the incidence of atherosclerosis is more in males as compared to females, in both sexes, it is alarming. This study highlights the importance of cardiovascular risk factors screening from early ages of the second decade. Our study aids valuable data to the literature regarding the morphology of atherosclerotic lesions. The study of the human atherosclerotic lesion is an extremely difficult task in a living subject and autopsy study is the best possible way to work on it.

There is an alarming increase in the number of deaths due to coronary atherosclerosis in India and this number is expected to escalate rapidly in the next decade. Atherosclerosis is a common phenomenon which is seen with different prevalence in different races. It begins in childhood and progresses through young adulthood to form the lesions that cause coronary heart disease.

CONCLUSION

This study highlights the importance of cardiovascular risk factors screening from early ages of the third decade. Our study aids valuable data to the literature regarding the morphology of atherosclerotic lesions.

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