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Postmortem Study of Hearts – Pathology of Coronary Artery Atherosclerosis

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Abstract

The most common cause of sudden death today is cardiovascular disease which is due to coronary artery disease unless otherwise proved. Coronary arteries get blocked by atherosclerotic lesions leading to myocardial ischemia followed by infarction. Present day lifestyle has contributed to the burden of this disease worldwide. Even the developing countries like India have increased incidence of coronary artery atherosclerosis. This study was undertaken to analyze the atherosclerotic involvement of three major coronary arteries with reference to the severity and the association of the disease with the age, sex, the major and minor risk factors. This is a study done on 100 hearts received after postmortem done in the department of Forensic medicine along with the details of the deceased person. Hearts were dissected and by making serial cuts along coronary arteries to look for the luminal blocks and bits were taken for histopathological study. In our experience coronary atherosclerosis is the main disease observed now increasingly in younger persons and other diseases such as cardiomyopathy and congenital heart disease are rare findings in postmortem. As coronary atherosclerosis do not cause symptoms until the disease is severe it is important to stress on early screening in all the adults especially in persons having risk factors.

Keywords: Coronary artery atherosclerosis; Postmortem study

Abbreviations: CAA: Coronary Artery Atherosclerosis; LAD: Left Anterior Descending Artery; RCA: Right Coronary Artery; LCX: Left Circumflex Artery; IHD: Ischemic heart disease;

Introduction

Infectious diseases and malnutrition were the common causes of death before 1900 and Cardiovascular disease (CVD) was responsible for less than 10% of all deaths. Now CVD accounts for 30% of deaths and is the most common cause of death worldwide. By 2030, 33% of all deaths will be due to CVD which comprises a group of diseases of the heart and vascular system which includes Ischemic heart disease (IHD), hypertension, cerebrovascular disease and congenital heart disease. IHD is likely to become the most common cause of death worldwide by 2020 [1]. According to WHO, IHD is the modern epidemic and the scenario in India is abysmal with highest loss of young people between the age of 35 to 64 years. The loss was 9.2 million years in the year 2000 and reported to reach 17.9 million years by 2030 which is 9.4 times more than the loss in the USA [2].

This is the penalty being paid for the increased use of tobacco, alcohol, fat rich diet and sedentary lifestyle of the people. IHD is a condition in which there is an inadequate supply of blood and oxygen to a portion of myocardium and the most common cause is coronary artery atherosclerosis (CAA). Autopsy specimens of heart provide a good understanding of these lesions when studied systematically. This research showed an increased occurrence of the disease in middle aged and older persons and more severe with the associated risk factors. Left anterior descending artery was the most common coronary affected. We have seen very few cases of congenital heart disease, hypertrophic cardiomyopathy and dilated cardiomyopathy in more than two decades of experience.

Methodology

Objectives of this research were to find out the frequency of CAA in random medicolegal autopsies, to analyze the role of smoking, diet and diseases such as, obesity, hyperlipidemia, diabetes mellitus and hypertension in its development. Comparison of CAA in relation to age, sex and socio-economic status was made. The distribution, morphology and severity of atherosclerotic lesions in different coronary arteries were

studied. The study included 100 randomly selected postmortems between a period of one and a half year. Only identified cases with complete data available were selected, with the written consent, detailed history from the closest relative of the deceased obtained. Hearts received in formalin were weighed, external examination findings were recorded such as amount of pericardial fat or any other abnormality. Dissection was done by Virchow's method and coronary ostea were examined. Three major coronaries left anterior descending artery (LAD), right coronary artery (RCA) and left circumflex artery (LCX) were studied by making serial cuts along their entire course at an interval of 3 mm [3]. Two bits were taken from the proximal and distal segment of each artery, routine tissue processing was done, and sections were stained with hematoxylin and eosin. Special stains such as Veroheoff's, Van Gieson, Masson's trichrome, Von kossa were used when necessary. Microscopically coronary atherosclerotic lesions were examined and categorized into six groups, according to American Heart Association (AHA) classification 1995 [4]. Types of lesions according to AHA are type I which is the initial lesion with isolated macrophages, type II with mainly intracellular lipid, fatty streak, type III with small extracellular lipid pools, type IV with core of extracellular lipid, type V with large lipid core and calcification and type 6 with haemorrhage. White, Edwards and Dry method was used to record the degree of stenosis, to grade the amount of luminal block in arteries and found to be a good method. Percentage of the lumen block upto 25% stenosis was considered grade 1, 26 – 50% block was grade 2, 51 – 75% was grade 3 and 76-100% stenosis was grade 4 [5].

Table 1: Occurrence of CAA In Different Age Groups and it is Present in All Persons After the Age of 30.

Age	Total Number of Cases	Positive Cases	%
Newborn to 10	1	0	0
20-Nov	7	3	42.85
21-30	23	19	82.6
31-40	23	23	100
41-50	21	21	100
51-60	17	17	100
61-70	5	5	100
71-80	3	3	100

Results

Out of the 100 hearts studied 81 belonged to males and 19 females, maximum number of cases were in 2nd and 3rd decade of age. Forensic department gave the cause of death as suicide in 47 cases, 39 cases of road traffic accidents and others such as accidental drowning, electrocution etc., 5 cases were due to homicide and 9 cases were reported as sudden natural deaths.

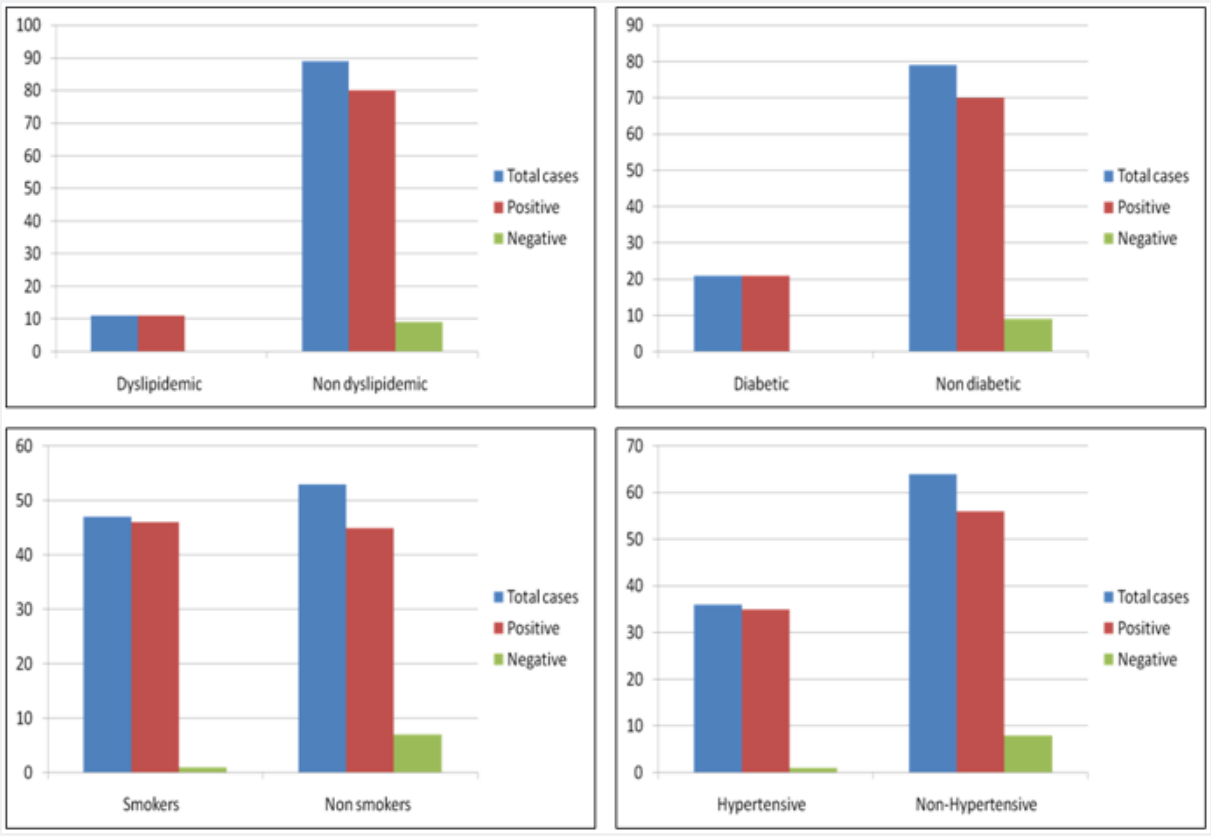

Figure 1: Association of High-Risk Factor: Graphs Show Higher Incidence of with Hyperlipidemia, Diabetes Mellitus, Tobacco Smoking and Hypertension.

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The involvement of coronaries with atherosclerosis starting from early lesions to the complicated plaques, the incidence found was 91%. Only 9 cases belonging to the younger age were negative. Males were more affected (92.5%) compared to females (84.2%). After the age of 30 years all the hearts showed coronary atherosclerosis and the severity of disease increased with age. Higher involvement was noted in affluent group of persons compared to the lower socioeconomic sections, 92.2% and 81.8% respectively. Non vegetarians had higher percentage (94.2%) compared to vegetarians (83.8%). There were 12 obese persons, 11 had dyslipidemia and 21 persons had diabetes mellitus and all of them (100%) had coronary lesions. Of the 36 persons with hypertension 35(97.2%) and of the 47 persons with history of smoking 46 (97.8%) (Figure 1), 39 of 41 cases of known alcoholics (95%) had CAA. There were 8 cases with left ventricular hypertrophy with type III in 3 cases, IV-2 cases, V-2 cases and VI in 1 case. Stenosis of the lumen were of grade I in 1, II in 3, III in 3, IV in 1case. Figures 2, 3 and 4 show all the six types of atherosclerotic lesions and grade I to IV stenosis.

Figure 2: Gross Specimen of Heart with Arrow Showing Grade Iv Block by Calcified Atheromatus Plaque in the Lad Coronary Artery.

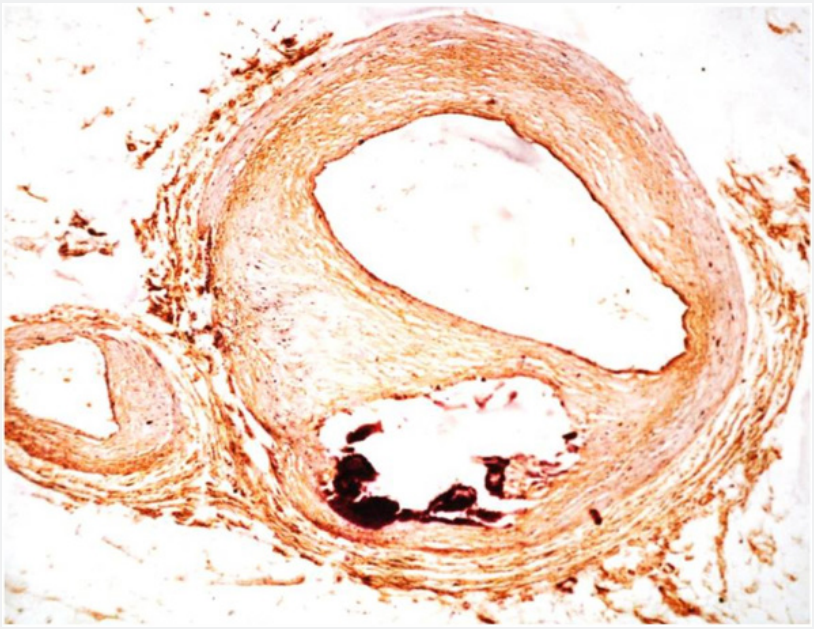

Figure 3: Verhoeff - Van Gieson Stain Highlighting the Fibrous Tissue in an Atheroma with Calcification, Type V Lesion Causing Grade2 Stenosis and a Smaller Artery Close to it also Shows Type III Lesion. × 25.

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Interestingly there were 9 cases of sudden natural deaths out of which 8 had type IV lesions in 3 cases, V in 3 cases, VI in 2 cases with grade II stenosis in 1 case, III in 3 cases, IV in 4 cases. There were 4 cases of myocardial infarction morphologically identifiable which showed type IV lesions in 1 case, V in 2, VI in 1case and with 2 having grade III and 2 cases with grade IV stenosis. CAA involvement in three arteries are shown in table.2 which reveals that LAD was affected in all and the involvement of proximal and distal segments are shown in the Table.3 with respect to stenosis.

Table 2: Percentage Involvement of Three Major Coronaries.

Artery	Number of Positive Cases
Left anterior descending	91 (100%)
Right coronary	83 (91.20%)
Left circumflex	74 (81.31%)

Discussion

This study recorded a frequency of CAA was 91% which is little higher than Golshai & Yazdi et al. [6,7]. There is increase in frequency of coronary atherosclerosis with increase in age which is in concordance with other studies conducted by Yazdi [7] & Monica Garg et al. [8]. Our study recorded frequency of 92.5% of CAA in males and 84.2% in females which is in same order as Yazdi [7] & Monica Garg, et al. [8] This study showed single vessel involvement of 6.59%, double vessel involvement of 20.87% and triple vessel involvement in 72.52% which is in same order of frequency as that of Yazdi et al. [2] and Monica Garg & Sudha, et al. [9]. LAD was the commonest to involved (100%), followed by Right Coronary Artery (94.50%) and Left Circumflex (83.51%) which is in the same order of frequency as that of Yazdi, Monica Garg & Sudha, et al. An older study by the main author of this article in 1992, showed 68.3% of CAA[10] (Table 4).Ministry of health and Family welfare, India has communicated that "Non communicable diseases including CVD, diabetes mellitus, chronic respiratory diseases and cancers account for over 60% mortality and according to World Economic Forum India stands to lose Rs. 311.94 trillion ($ 4.58 trillion) between 2012 to 2030 due to these diseases [11].

Table 3: Involvement by CAA and Degree of Stenosis in Three Coronaries P – Proximal and D – Distal Segments.

	Coronary Artery					
	LAD		RCA		LCX	
	P	D	P	D	P	D
I	9	12	29	33	32	35
II	22	26	23	21	17	17
III	16	20	12	9	13	9
IV	20	15	10	7	8	4
V	21	12	8	5	4	2
VI	3	1	1	0	0	0
TOTAL	91	86	83	75	74	67

Table 4: Difference in Occurrence of CAA with Steep Increase in Recent Times.

		Kusuma v, Jayakeerthy [11]	Golshahi [7]	Yazdi et al. [8]	Monica Garg [9]	Present Study
Frequency		68.30%	Atheroma 29.4%	71.20%	100% (Atheroma) 46.4%	91%
Sex	Male	82.20%	Atheroma 31.3	73.10%	100%	92.50%
	Female	26.60%	Atheroma 13.6	61.50%	100%	84.20%
Age	21-30	45.50%	-	25.80%	100% (14.3%)	82.60%
	31-40	75.50%	-	63.70%	100%	100%
	41-50	88.80%	-	78.50%	100%	100%
	51-60	100%	-	-	100%	100%
Pattern of vessel involvement		LAD>RCA>	LAD>RCA>	LAD>RCA	LAD>RCA	LAD>RCA
		LCX	LCX	>LCX	>LCX	>LCX
No of vessel involvement		3>2>1	-	3>2>1	3>2>1	3>2>1

Conclusion

There is alarmingly higher occurrence of CAA that too presenting in younger age group when compared to two decades back. Left anterior descending artery is the most common site for atherosclerosis. There is strong positive correlation with major risk factors, and the disease does not cause symptoms in early stages highlighting the importance of screening programmes. Majority of sudden natural deaths are due to CAA leading to

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IHD. It is high time for everyone to change the lifestyle, taking good care of health, with proper nutritious diet, keeping physical fitness, leaving tobacco smoking, alcohol and to have a regular check on diabetes and hypertension.

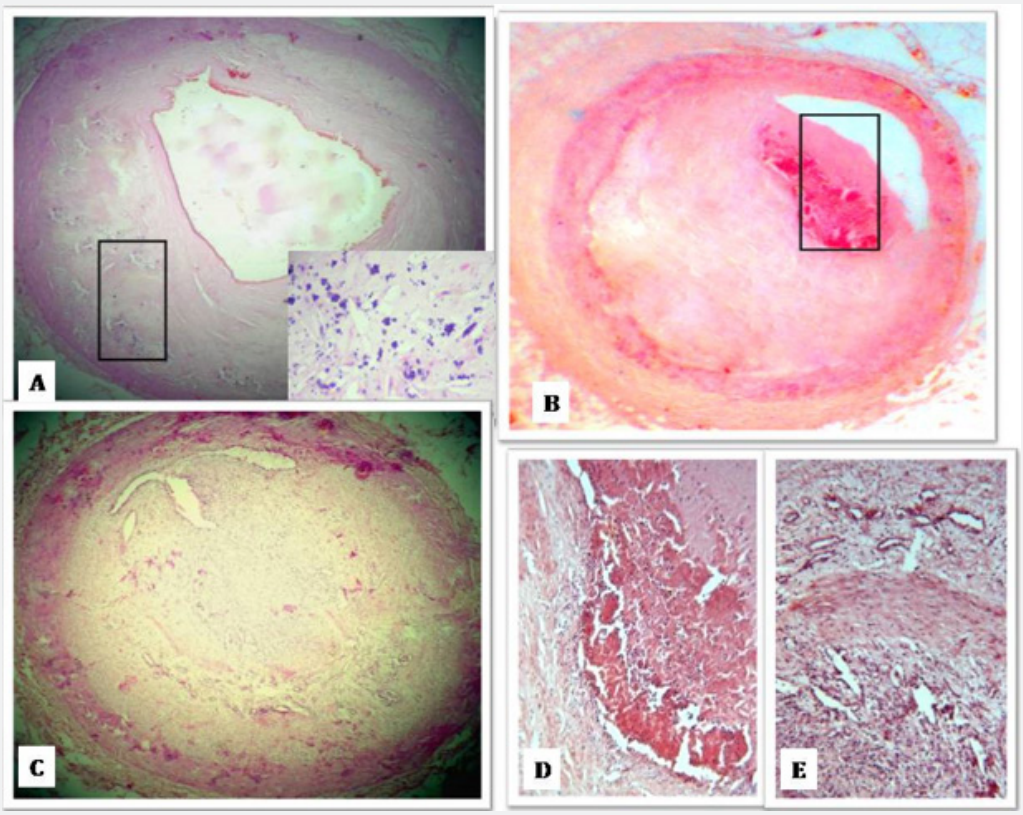

Figure 4:
(A) Coronary Artery Showing Grade 2 Stenosis with Calcified Plaque,
(B) Grade 3 Stenosis with Type VI Lesion with Haemorrhage,
(C) Shows Complete Block by Atheroma and Thrombus Having Recanalisation, H & E, × 25,
(D) Shows Haemorrhage In Atheroma And
(E) Shows Recanalisation, H & E, × 40.

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