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Research Article

CORONARY ATHEROSCLEROSIS RELATED MORALITY: AN AUTOPSY STUDY

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ABSTRACT

Background: Atherosclerosis is a chronic inflammatory and healing response of the arterial wall to endothelial injury. Atherosclerosis is a multifactorial disease of large and medium sized arteries. In case of sudden death cardiovascular disease (45-50%) was the most important cause of the sudden natural death among population. Coronary artery disease is responsible for over 70% of sudden cardiac death.

Aims and Objectives:

1. To study the frequency of atherosclerosis in coronary arteries.
2. To attribute atherosclerosis as the sole cause of natural deaths.
3. To classify atherosclerosis lesions in coronaries as per American Heart Association grading for atherosclerosis.

Material and Methods: The present study is cross sectional, observational carried out in the Department of Pathology at Tertiary Health Care Center during June 2018 to June 2022.A total of 1076 autopsy specimens were received. The heart was examined grossly. Distribution of atherosclerotic lesion in different coronaries was noted and microscopic grading of atherosclerosis was done using the Modified American Heart Association (AHA) classification of atherosclerosis. **Result:** Atherosclerosis was seen in 383 cases. The most common age group affected was 31-40 years in 103 cases (26.89%). Common cause of death was coronary atherosclerosis related morality in 45.69%. **Conclusion:** Despite major advances in medical interventional and surgical studies assessment of coronary atherosclerotic lesions in living subjects is difficult due to its invasive nature and high cost. So autopsy based study of coronary vessel is an invaluable tool for studying these lesions in deceased subjects.

INTRODUCTION

Atherosclerosis is a chronic inflammatory and healing response of the arterial wall to endothelial injury. [1]Atherosclerosis is a multifactorial disease of large and medium sized arteries characterized by plaque like intimal deposition which contain neutral fats, cholesterol, lipophages, and blood elements at times haemorrhages and calcification. Complications of atherosclerosis are disastrous like ischemic heart disease, cerebral stroke, peripheral gangrene.[2] Coronary occlusion is the partial or complete occlusion of blood flow in a coronary artery. This condition may cause a heart attack. In case of sudden death cardiovascular disease (45-50%) was the most important cause of the sudden natural death among population. Coronary artery disease is responsible for over 70% of sudden cardiac death.[3] Atherosclerosis coronary artery disease is the commonest cause of premature death in developed countries globally.[4] Lifestyle and dietary habits are the major contributory factors for the changing trends.[5] The number of resources available in rural and semi-urban population in India for studying atherosclerosis are limited. Despite modernization in medicine, the diagnosing tools lack in accuracy to find clinical cause of death.[6.7]An autopsy study gives a good measure of the prevalence, grading and distribution pattern of atherosclerosis lesions in coronaries. Identifying the prevalence of sub clinical atherosclerosis in a population helps the health administrators to plan preventive measures and strategy to prevent death in young age.[8]

MATERIAL AND METHODS

The present study is cross sectional, observational and was carried out in the Department of Pathology at Tertiary Health Care Center during the period of 4 years from June 2018 to June 2022.

A total of 1076 autopsy specimens were received in the department.

Total number of cases reviewed for evidence of atherosclerosis and/or other comorbid lesions was 551 (a total of 345 cases excluded as per exclusion criteria).

Relevant clinical data was retrieved from case record.

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All specimens received in the autopsy section were fixed in 10% formalin. Dissection of the heart was done as per merit of the case.

1. Weight of the heart was noted.
2. A detailed gross examination of received organs were done.
3. Evidence of pulmonary embolism was seen.
4. Coronary ostia was seen for evidence of atherosclerosis and thrombi.
5. Circumference of mitral, tricuspid, pulmonary and aortic valve were noted.
6. Coronaries were dissected by either transvers method or longitudinal method depending on evidence of thrombi and calcification. Coronary arteries dissected were Left coronary artery (LCA), Left anterior descending artery (LAD), Left circumflex artery (LCX), and Right coronary artery (RCA). Each coronary was dissected at 3mm intervals to examine for any atherosclerotic plaques. The coronaries were examined grossly for the presence of thrombus, narrowing of the lumen, plaque of atherosclerosis and calcification. Tissue bits were taken from LAD, LCA, LCX and RCA from gross atherosclerotic lesions as well as suspicious lesions for microscopic assessment of atherosclerosis. If no lesions identified, random tissue bits were taken from above mentioned four sites.
7. Measurement of thickness of right ventricular wall, left ventricular wall, inter-ventricular septum and both atria were taken. Tissue bits from calcified plaque were kept for decalcification.

Pathological findings in the gross examination of organs were noted and sections from representative areas were taken.

The dissection of the heart was done by either of the two methods.

1) Inflow outflow technique
2) Short axis method of cardiac dissection

Inflow outflow technique

This technique was used in pediatric hearts, so the atrial septal defects and ventricular septal defects are not missed. For each side of the heart, the atrium was opened first. After the opening of the atrium, ventricles were opened along its inflow and outflow tract of blood. A minimum of one section was taken from each of the heart chambers and then additional sections were taken from gross changes of the representative pathological area.

Short axis method of cardiac dissection

For adult hearts, the dissection was done using this method so as to expose maximum area; therefore, ischemic heart diseases were not missed by this method. First, all coronaries were dissected along the course and a minimum of one section from each coronary was taken. Then the aorta was opened, both coronary Ostia were examined for atherosclerosis if the normal, representative section was taken. Additional sections were taken if gross changes of atherosclerosis were seen. After coronaries, the flat diaphragmatic surface of the heart was placed on a paper towel and then 1 – 1.5 cm thick slices were made using a sharp knife. Extensive sectioning was done, so that focal disease was not missed. Minimum one section from each atrium and ventricle were taken along with one section from the apex, papillary muscles and interventricular septum. A minimum number of sections from the myocardium taken were 7, plus additional sections from suspected areas.Sections were processed in a semi-automated tissue processor and routine paraffin embedding was done. Then paraffin blocks were cut on rotary microtome. The obtained thickness of each section was four to five microns. Then the sections were stained with hematoxylin & eosin stains. Special stains were employed as per the merit of the case. After detailed microscopic examination, pathological findings were noted. Distribution of atherosclerotic lesion in different coronaries were noted and microscopic grading of atherosclerosis was done using the Modified American Heart Association (AHA) classification of atherosclerosis.

Causal relationship between coronary atherosclerosis and death were commented.Frequency of coronary atherosclerosis was correlated with sex and age group.Causes of death other than atherosclerosis were noted.

American Heart Association criteria for grading atherosclerosis[4]

Grade 0	:	Section showing normal histology or adaptive thickening without macrophages or foam cells.
Grade 1	:	Presence of isolated macrophages foam cells.
Grade 2	:	Intracellular lipid accumulation with formation of multiple foam cell layers.
Grade 3	:	Grade 3 lesions along with small extracellular lipid pools.
Grade 4	:	Grade 2 changes along with a core of extracellular lipid.
Grade 5	:	Lipid core and fibrotic layer or multiple lipid cores and fibrotic lipid layers.
Grade 6	:	Complicated plaques with surface defects, and/or hematoma hemorrhage, and/or thrombosis.

Observation and results

The present observational study was carried out in the department of pathology at a tertiary health care center during the period of 4 years from June 2018 to June 2022. A total of 1076 autopsy specimens were received in the department. After applying exclusion criteria, the total number of cases reviewed were 551.

Table 1: Age wise distribution of cases of atherosclerosis (n=383)

Age	Number of cases	Percentage
13-20	8	2.08%
21-30	69	18.01%
31-40	103	26.89%
41-50	79	20.62%
51-60	67	17.49%
61-70	43	11.23%
71-80	11	2.87%
81-90	1	0.29%
91-100	2	0.52%

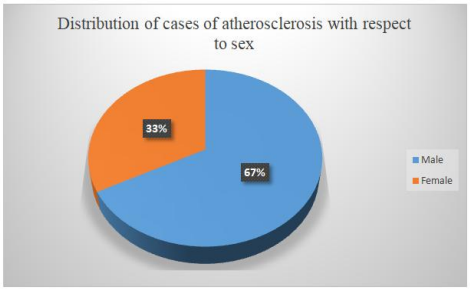


Chart 1: Distribution of cases of atherosclerosis with respect to sex

When we analyzed all the four vessels in all cases, occurrence of Grade III lesion was commonest finding in 98.95% (379 vessels).Most commonly affected coronary artery was LAD accounts for 89.03 % (341vessels).

Table 2: Distribution of coronary artery according to grade (n = 383)

Artery	Grade O	Grade I	Grade II	Grade III	Grade IV	Grade V	Grade VI	Total	%
LCA	63	45	75	112	41	39	8	320	83.55
LAD	42	40	78	116	55	45	7	341	89.03
LCX	138	43	69	71	32	28	2	245	63.96
RCA	92	48	83	80	38	39	3	291	75.97
Total	335	176	305	379	166	151	20		

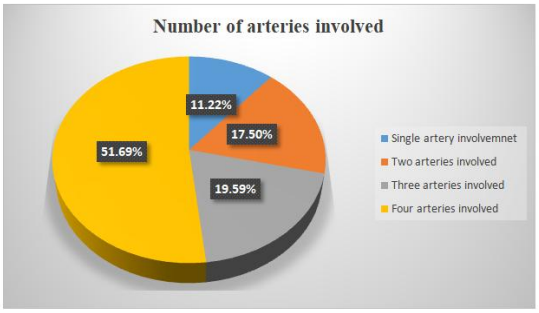


Chart 2: Numbers of arteries involved (n=383)

The most common presentation was breathlessness 17.23% (66 cases), followed by unconsciousness 15.1% (58 cases), chest pain 10.7% (41 cases) and sudden death 7.31% (28 cases) respectively. (Please note as one patient present with more than one clinical features total number of cases do not match.)

Acute coronary syndrome contribute 21.97% (9 cases) for death in cases presenting with chest pain or chest pain with breathlessness. Acute coronary syndrome contribute 35.71% (10 cases) for death in cases presenting with chest pain or chest pain with breathlessness in sudden death syndrome. In present study most common cause of death was coronary atherosclerosis related morality in 45.69% (175 cases) followed by in Myocarditis / Pericarditis / Endocarditis 9.39% (36 cases).

Chronic ischemic heart /chronic myocardial infarction disease was found in 17.23% (66 cases) and acute myocardial infarction was found in 2.87% (11 cases)out of 77 cases of myocardial infraction. In myocardial infarction cases four vessel involvement was more common seen in 74.04% (57 cases) followed by three vessel involvement seen in 19.48% (15 cases), two vessel involvement seen in 5.19% (4 cases) and 1.29% (1 case) showed single vessel involvement. Out of 77 cases of myocardial infarction 33.76% (26 cases) each show 41-60%, 61-80 % luminal occlusion, followed by 21-30% luminal occlusion in 18.20% (14 cases), 81-100% luminal occlusion in 9.09% (7 cases) and 0-20% luminal occlusion in 5.19% (4 cases).

DISCUSSION

Historically the autopsy has fulfilled multiple purposes including those pertinent to medical care, medical science and family counselling. Even though a lot of medical advances have occurred like various imaging studies and highly claimed biomedical markers in coronary artery disease, the importance of the autopsy remains unchanged. The autopsies are important in teaching, quality assurance and determination of exact cause of death. In other words there is no valid method of sampling of living population especially when the death is sudden, autopsy serves the purpose as it is said "*Mortus Vivous Docent* -The Dead teach the Living". The autopsy studied help in understanding the differences in type, extent, and severity of atherosclerosis lesions in the population. The autopsy studied department of pathology at tertiary care hospital. To avoid a sampling bias all the heart specimens received during the period of four years extending from June 2018 to June 2022 were evaluated for the evidence of coronary atherosclerosis. Total 551 autopsy heart specimens were received. The analysis included frequency/magnitude of atherosclerosis in coronary artery disease, their classification according to American Heart Association grading system and the cause of death as the sole cause for natural deaths.

A total of 551 autopsy specimens were analyzed for the evidence of atherosclerosis during the study period of four years. Out of these, 383 cases showed atherosclerosis. Thus present study recorded a magnitude/frequency of 69.50% which correlate with study done by Garg M et al (2011)[9] 46.4%, Vyas P et al. (2015)[10]73.45%. The interesting observation is increasing frequency/ magnitude with advancing period. This may be explained on the basis of changing life style pattern in the population over the period extending from 2011 onwards.

Atherosclerosis was found to be affecting all the age groups the youngest patient presented at the age of 16 years and the oldest patient at the age of 100 years. The maximum frequency was found between the age group of 31-40 years, followed by the age group of 41-50 years. This study closely resembles a study by Dhruva G.A et al(2012)[11], Mothakapalli JT. et al (2012)[7], Prabhu M. H et a (2013)[12] , Vyas P. et al(2015)[13], Khiste J.A et al(2018)[4],Rahimi R et al(2018)[14], Thiripurasundari R et al.(2019).[15]

The present study showed male preponderance with a male to female ratio of 2.06:1. The findings in the present study are well correlated with study done by Mothakapalli JT. et al (2012) [7],Prasad V N. et al. (2014)[5] and Azeke et. al (2020) [16]this studies showed male to female ratio of 2.2:1, 2.2:1 and 2.8:1

Grade III was the most common category according to AHA classification contributing 24.73% of the cases, which correlated with Garg M et al. (2011)[9], Khiste J.A. et al. (2018) [4] seen in 26.08% and 23.75%.

LAD was the most commonly affected coronary vessel accounting for 89.03% which correlated with other studies done by Khiste JA et al (2018) [4], Dhingani N et al **(**2018) [17]seen in 87.5% and 85%.

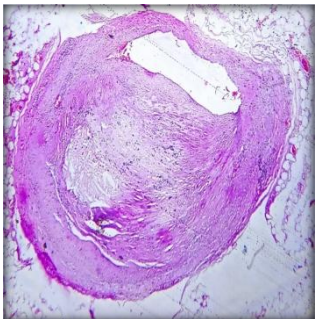
Almost half of the cases that is 51.95% all four coronary arteries (LCA, LAD, LCX and RCA) were involved. Study done by Vyas P et al. (2015)[10]and Sharma S et al (2016) [2]reported three vessel involvement. The difference is due to fact that all other studies dissected only three vessels that is

LCA, LAD and RCA while all four coronary vessel were studied in the present study.

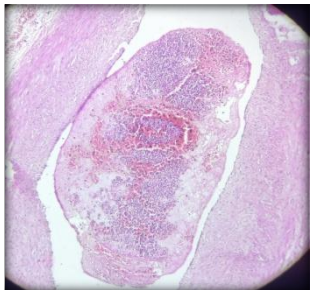
Sudden death was seen in 28 cases as per definition by WHO. There were acute coronary syndrome was cause of death in 10 cases and myocardial infarction either acute or chronic due to atherosclerosis was seen in 5 cases, accounting for 53.57% of total. Our findings correlate with Kasthuri ASet al (2002)[18]Rahimi R et al (2018)[14]and Pandian JR et al (2020)[6]76.9%, 61.9%and 49.25%. These studies also indicating that coronary atherosclerosis and its sequelae is prominent cause in sudden death accounting for more than half of the cases.

AMI or chronic ischemic heart disease accounting for 20.10% (77cases) of the total 383cases demonstrating coronary artery atherosclerosis. Out of these 77 cases AMI was observed in 11 cases while chronic ischemic heart disease in 66 cases. Farb A et al (1995)[19], Vyas P et al (2015) and Singh P et al (2018)[20] found chronic ischemic heart disease as the most common lesion with 10 (11%), 11 (13.25%) and 28 (13.02%) of the cases respectively. Whereas Purushottam R et al (2017)[21], and Dhingani N et al (2018) [17]found acute MI as the most common lesion with 17 (12%) and 29 (4.97%) cases respectively. In our study many cases with chronic ischemic heart disease did not reveal a traditional wisdom of significant coronary occlusion of > 70%, supporting the view claimed by some researchers stating that non obstructive coronary artery disease is not "insignificant" but rather is associated with a significant and quantifiable risk for cardiovascular morbidity and mortality.

Figure 1: Photograph showing atherosclerosis With complete occlusion of vessel



Photomicrogrpah 1: Photomicrograph showing atherosclerosis Grade V (Stain – Hematoxylin and eosin, magnification x 10)



Photomicrogrpah 2 : Atherosclerosis with thrombus Grade VI (Stain – Hematoxylin and eosin, magnification x 10)

CONCLUSION

- Despite major advances in medical interventional and surgical studies assessment of coronary atherosclerotic lesions in living subjects is difficult due to its invasive nature and high cost. So autopsy based study of coronary vessel is an invaluable tool for studying these lesions in deceased subjects.
- Irrespective of the presenting symptoms or final cause of death magnitude of atherosclerosis was found alarmingly high (69.50%).
- Most commonly affected coronary artery was Left anterior descending artery accounted for 89.03 % (341vessels).
- Grade three atherosclerosis was more common accounting for 24.73%.
- Coronary atherosclerosis alone or its complication myocardial infarction is responsible for more than half death in sudden death syndrome.
- Non critical coronary atherosclerosis (nonobstructive) can cause chronic myocardial infarction/chronic ischemic heart disease.

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