Original Research Article

A Study of Coronary Atherosclerosis in Sudden Cardiac Death

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Abstract: The largest cause of morbidity and mortality in developed and developing countries today is overwhelmingly contributed by atherosclerosis. This autopsy study was designed to analyze the coronary arterial tree in cases diagnosed as sudden cardiac death in the casualty department of our hospital, classify coronary atherosclerotic plaques and to assess the factors contributing to vulnerability of the plaques including inflammation, calcification, erosion and rupture. Heart specimens from adult autopsies conducted on cases of sudden cardiac death were analyzed. Cases were selected on the basis of the history of the chest pain or sudden collapse followed by death or brought dead within 1 to 6 hour. Control cases were selected as vehicular accidental deaths. A diagnosis and conclusion was made by studying the sections of coronary arteries (H&E stain, Modified Elastic Trichrome stain and Verhoeff's - Von giesson's stain) obtained from heart of victim of sudden cardiac death. Changes of atherosclerosis are better appreciated when conventional H & E stain is complimented by special stains like the Modified elastic trichrome stain and Verhoeff's – Van Geison stain that highlight the elastic tissue fibres, collagen fibres and inflammation. Use of these special stains in routine autopsy study will help the beginner to learn.
Keywords: Atherosclerosis, Coronary artery disease, Modified elastic trichrome, Verhoeff's – Van Geison.

INTRODUCTION

The largest cause of morbidity and mortality in developed and developing countries today is overwhelmingly contributed by atherosclerosis [1]. The incidence of coronary artery disease has doubled in India during the past three to four decades. Considering the variation in racial, dietary and life style patterns in our population it is essential to study morphology and evaluation of coronary atherosclerosis in our population [2, 3]. It is widely accepted that rupture of vulnerable atherosclerotic plaque leads to acute coronary syndrome. Important characteristics of unstable or vulnerable plaques are a large lipid core, a thin fibrous cap and many inflammatory cells including macrophages. This autopsy study was designed to analyze the coronary arterial tree in cases diagnosed as sudden cardiac death in the casualty department of our hospital, classify coronary atherosclerotic plaques and to assess the factors contributing to vulnerability of the plaques including inflammation, calcification, erosion and rupture [4, 5]. The purpose of present study was to systemically observe the atherosclerotic changes in coronary artery in sudden cardiac death, to demonstrate prevalence, grading and distribution pattern of atherosclerosis; to find out association between severity

of coronary atherosclerotic change and sudden cardiac death; to demonstrate plaque size and plaque variability like vulnerable plaque, non vulnerable plaque, erosive plaque and rupture plaque in sudden cardiac death due to coronary atherosclerosis and to demonstrate effect of atherosclerosis on internal elastic lamina by using modified elastic trichrome stain and Verhoeff's-Van giesson's stain.

MATERIAL AND METHODS

Present study was a prospective study of atherosclerotic changes in coronary arteries. Heart specimens from adult autopsies conducted on cases of sudden cardiac death were analyzed. Cases were selected on the basis of the history of the chest pain or sudden collapse followed by death or brought dead within 1 to 6 hour. Control cases were selected as vehicular accidental deaths. Cases who had malignancy, renal disease, diabetes mellitus or predominant other systemic disorder were excluded from present study. All these cases with such history from casualty dept of our hospital over a period of two year July 2014 to June 2016 are included in the study. After autopsy, the hearts were immersed in formalin and allowed to fix on the same day. Entire coronary tree was dissected along with

its major branches. These vessels were decalcified for a period of 15-20 minutes. (HNO_3 solution). Following decalcification, the entire left coronary and left anterior descending artery and right coronary artery were sectioned at 3 mm intervals. After routine processing and paraffin embedding, 4 µm sections at least 4 sections from one block were taken. As mentioned below various stains were performed:-

1. Haematoxylin and Eosin stain.
2. Modified Elastic Trichrome stain.
3. Verhoeff's - Von giesson's stain.

A diagnosis and conclusion was made by studying the sections of coronary arteries obtained from heart of victim of sudden cardiac death.

RESULTS AND DISCUSSIONS

In our study we found the following results:

Of the 100 cases, 81% were males and 19 % were females. The M: F ratio was 4:1. Thus, a predominant male preponderance was observed. Maximum number of cases was in sixth decade (50-59 yrs) followed by fifth (40-49 yrs) and seventh decades (60-69 yrs). The youngest age of presentation was 10 yr and the eldest reviewed in the study was of 85 yrs. Subendothelial thickness, foam cells and fibrosis were the predominant changes observed in the intima. In the internal elastic lamina most common findings were duplication and fragmentation and attenuation. In the tunica media most common findings were fibrosis, vascularization and attenuation.

Table 1: Grading of atherosclerosis as per AHA Classification (Grade I, II, III, IV, V) (n=100)

Age groups	Grade I			Grade II			Grade III			Grade IV			Grade V		
	Male	Female	Total	Male	Female	Total	Male	Female	Total	Male	Female	Total	Male	Female	Total
0-9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10-19	1	0	1	0	0	0	1	0	1	0	0	0	0	0	0
20-29	0	1	1	1	0	1	0	0	0	1	0	1	0	0	0
30-39	0	0	0	2	0	2	3	1	4	2	0	2	0	0	0
40-49	0	0	0	3	0	3	4	0	4	3	0	3	2	1	3
50-59	0	0	0	1	0	1	7	2	9	8	1	9	8	2	10
60-69	0	0	0	0	0	0	3	1	4	3	0	3	0	1	1
70-79	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0
80-89	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0
Total	1	1	2	7	0	7	18	5	23	18	1	19	10	4	14

Table 2: Grading of atherosclerosis as per AHA Classification (Grade IV, V, VI, VII, VIII) (n=100)

Age groups	Grade VI			Grade VII			Grade VIII			Absent			Total
	Male	Female	Total	Male	Female	Total	Male	Female	Total	Male	Female	Total	
0-9	0	0	0	0	0	0	0	0	0	0	0	0	0
10-19	0	0	0	0	0	0	0	0	0	0	0	0	2
20-29	0	0	0	0	0	0	0	0	0	1	0	1	4
30-39	1	0	1	1	0	1	0	0	0	1	1	2	12
40-49	1	0	1	1	0	1	0	0	0	2	2	4	19
50-59	5	1	6	3	1	4	0	0	0	3	1	4	43
60-69	4	1	5	1	0	1	0	0	0	0	0	0	14
70-79	2	1	3	0	0	0	0	0	0	0	0	0	4
80-89	1	0	1	0	0	0	0	0	0	0	0	0	2
Total	14	3	17	6	1	7	0	0	0	7	4	11	100

Grade III,IV,V,VI were seen in the sixth decade with male predominance, while in females, Grade III and Grade V were observed during sixth decade followed by Grade VI during sixth to eighth decade. Overall atherosclerosis was found in sixth decade [6-8].

In 57 significant atheromas, 90 coronaries sectioned showed vulnerable plaque, mainly as compared to non-vulnerable plaque. Total 07 calcified plaque, 16 ruptured plaque and 17 with eroded plaque were identified while 49 plaques showed inflammatory cells.

In present study all the sections were stained by H&E stain, Modified elastic trichrome stain and Verhoeff's-Von Giesson's stain. H&E stained section showed better visualization of foam cells, fatty streaks and dusty and prominent calcification, IEL could be observed with experience. Verhoeff's-Von giesson's stain was good in visualization of IEL. And modified elastic trichrome was the best in visualization of hemorrhage, neovascularisation, collagen fibers, IEL, fibrofatty tissue.

Control cases: In the present study 10 cases of vehicular accident were taken as a control that had no any previous history of cardiac pathology, age ranging from 2 month old child to 75 year male. All cases showed no changes of atherosclerosis except one case aged 75 year male showed significant atherosclerosis in left anterior descending artery(single vessel block) as a incidental finding and another case of 25 years male showed foamy cells in the intima. Coronary of 2 month old child showed normal intima with waviness of internal elastic lamina and no sign of atherosclerosis.

CONCLUSIONS

As a consequence to the aim of the present study, the following conclusions are made:

1. The changes of atherosclerosis increase with increasing age.
2. There is a prominent gender bias with a male predominance among patients showing changes of atherosclerosis.
3. Left anterior descending artery has been observed to be the commonest artery involved with vulnerable plaques being the most common cause of death among cases of sudden cardiac death.
4. Changes of atherosclerosis are better appreciated when conventional H & E stain is complimented by special stains like the Modified elastic trichrome stain and Verhoeff's – Van Geison stain that highlight the elastic tissue fibres, collagen fibres and inflammation. Use of these special stains in routine autopsy study will help the beginner to learn. Modified elastic trichrome stain was better in comparison to Verhoeff's-Van Geison stain for plaque morphology, neovascularization, and hemorrhage and fibrofatty component. The internal elastic lamina was stained equally well by Modified elastic trichome and VH-VK stain. H & E stain showed calcification and foam cells the best [9, 10].
5. The study of the changes of atherosclerosis and presence of mild grades of atherosclerosis even in younger population will be helped for any evidence of the disease which will be useful for earlier interventions by clinicians without neglecting the presentation.
6. Considering the variation in racial, dietary and life style patterns and other risk factors producing their effect since younger age, one will have to change for better and healthier life to prevent the unexpected loss of younger population. As it true statement for all diseases but particularly it is a very much fact for CHD - 'Prevention is better than cure'.

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