CORONARY ATHEROSCLEROSIS IN ALIGARH DISTRICT,
UTTAR PRADESH.
A MORPHOLOGICAL STUDY


The present communication deals with the observations of the type and extent of atherosclerotic lesions in coronary arteries obtained from 108 heart specimens. In 81.4% cases the lesions were present. The earliest lesion of fatty streak was noticed in 2nd decade whereas all the cases above 4th decade had atherosclerotic lesion. Fatty streaks involved 4.5% of the intimal surface in 2nd decade, reaching a maximum to 26% in 6th decade and later on receding to 12% in 7th decade. Fibrous plaques were seen in later period of 2nd decade involving 2% of the surface area. There was a slow and tardy progression of the lesion with the maximum involvement of 32% in 7th decade. Complicated lesions were seen in 3rd decade but involved only 7% of the surface in 7th decade. Left coronary artery was involved in 79.62% cases and the right in 78 (72.22%).

Salient histomorphological changes as well as degenerative changes occurring in the development of the disease process have been discussed. Main differences in the natural history of the disease in Indians were the slow progression of fibrous plaque and a very low incidence of grade IV lesions (complicated lesions). Marked disparity between the lesions observed in coronary arteries and root of aorta was noticed.

MARKED qualitative and quantitative differences in atherosclerotic involvement of aorta and coronary arteries among various ethnic groups of the world have been reported1-10. These may be due to different methods employed for assessing the severity of the lesions or the absence of unanimity on nomenclature and ideas about the morphogenesis of the disease process10 or variation in the progression of fatty streaks to fibrous plaques and complicated lesions5,9,11 or to the difference in the tendency for thrombosis which is mainly responsible for the progression of the disease12-15.

In Indians blood vessels are less commonly involved by fibrous plaques and complicated lesions which are responsible for decreased frequency of clinical manifestations9,16. With this background of marked variation in the incidence and pattern of atherosclerosis an attempt has been made in the present communication to report the observations on the pattern of coronary atherosclerosis in Aligarh District, Uttar

Key Words:
Coronary atherosclerosis
A morphological study

(Received on May 2, 1978; Accepted on July 1, 1978)
From the Section of Morbid Anatomy, Department of Pathology, Jawaharlal Nehru Medical College, Aligarh
Muslim University, Aligarh-202001, India
* Reader in Pathology
** Research Fellow under the Indo-Afghan Cultural Exchange Programme.
*** Professor and Head, Department of Pathology
**** Ex-Chief Medical Officer, Aligarh District.
Pradesh, on the basis of gross and microscopic examinations of coronary vessels.

MATERIALS AND METHODS

The material in the present study comprised of 108 hearts obtained from medico-legal post-mortems conducted at the Malkhan Singh Hospital, Aligarh. From formaline fixed hearts the coronaries were dissected out from their beds from the ostia to their bifurcation. The vessels were exposed longitudinally and stained according to the technique of Holman et al.\textsuperscript{17} The vessels were examined on gross aided by hand lens and the grading and extent of the type of the lesion was done in conformity with W.H.O. Study Group Classification.\textsuperscript{18} From every vessel two blocks were taken from the suspected lesion or diseased portion and one from the normal looking area. The presence of diffuse sudanophilia involving the intima without its elevation was also noted.

Paraffin blocks were prepared and sections were cut at 4 to 5 µ thickness. Besides routine haematoxylin and eosin staining special stains like Verhoeff van Geisen for elastic tissue, von Kossa for calcium and Periodic Acid Schiff (PAS) for mucopolysaccharides were done. Fat was demonstrated by examining the unstained frozen section for cholesterol crystals under polarising microscope or studying the sections stained with Sudan IV.

OBSERVATIONS

Gross Assessment:

Out of 108 cases, only one was below 10 years of age and did not show any evidence of atherosclerosis. Out of 12 cases of 2nd decade four had atherosclerotic lesion (33.33%), 37 cases of 3rd decade had lesions in 75.7%, 28 cases of 4th decade in 92.8%, while above onwards all cases showed some or the other form of atherosclerosis. The various types of lesion seen in different age group and the percentage of the surface involved is shown in Fig. 1. The earliest grossly visible lesion appearing in 2nd decade involved 6.5% of the total surface. This was followed by a gradual increase in the surface involved and in 7th decade nearly 56% of the intimal surface was affected.

Complicated lesions (Fig.2) were observed to appear in 3rd decade reaching a maximum involvement of intimal surface (7%) in 7th decade. Out of 108 cases the left coronary artery (LCA) was involved in 86 cases (79.62%) and the right coronary artery (RCA) in 78 (72.22%). In 8 cases only RCA was involved whereas in 2 cases RCA was alone involved.

Microscopic study:

Intimal thickening was observed in two forms—either as diffuse intimal thickening (Fig. 3) seen in 8.3% cases in LCA and 13.9% in RCA or as

![Graph showing involvement of intimal surface by different types of atherosclerotic lesions.

Fig.1.

![Image showing both the coronary arteries showing calcified areas, left depicting lead pipe type artery.

Fig.2.

*Japanese Circulation Journal Vol. 42, September 1978*
localised thickening observed in 75.9% and 62.9% of cases in relation to LCA and RCA respectively. The second form of thickening was more marked particularly at the bifurcation of the artery and was responsible for narrowing of calibre.

Japanese Circulation Journal Vol. 42, September 1978

The earliest lesion was characterised by a smooth surface mass raised above the level of the surrounding non-atherosclerotic vascular intima. Histologically the lesion contained foamy cells, presumably macrophages or lipophages situated in subendothelial area (Fig.4). Mild degree of
lymphocytic infiltration was seen at the site of lipid deposition. In fully developed fatty streaks lipid substance was present extracellularly in the form of cleft like spaces. No cellular infiltration was seen at this stage.

Morphologically the lesion fibrous plaque was characterised by the presence of atheromatous deposit in the deeper part of the intima with overlying fibrous cap resulting into intimal thickening (10–12 times of the media) and narrowing of lumen (Fig.5). In fully developed plaque the internal elastic lamina was either fragmented or absent. The plaque was also infiltrated by mono-nuclear cells seen in 31.5% and 18.5% in LCA and RCA respectively.

The other morphological changes observed in both the coronary arteries have been depicted in Fig.6. Vascularisation of the plaque occurred in two ways. In 11 cases it was superficial towards the luminal surface while in six cases the blood capillaries were present in deeper part of the plaque.

The degenerative changes observed were hyalinisation, mucoid degeneration and calcification. Hyalinisation was associated with calcification in 11.1% cases (Fig.7), with mucoid change in 6.48% and with both in 5.6% cases. Calcification was present either in the form of big mass or fine granules or both. The progres-

Fig.5. Fully developed fibrous plaque showing mononuclear infiltration of adventitia, medial atrophy, cholesterol crystals and fibrosis. H. & E. x 50.

![Graph showing frequency of different changes in left and right coronary arteries.](image)

**Fig.6.** Frequency of different changes occurring in left and right coronary arteries.

*Japanese Circulation Journal Vol. 42, September 1978*
sion of atheromatous lesion led to the narrowing of the lumen. In one case both the coronary arteries were markedly narrowed down particularly the left by repeated layering of calcified material and fibrosis (Fig. 8 and 9). It was really alarming to think how this person was surviving. Occurrence of haemorrhage and thrombus formation was comparatively low, however, it was more frequently seen in LCA as compared to RCA. Under polarising microscope cholesterol
DISCUSSION

From the data presented there is no doubt that the atherosclerosis of the coronary arteries occurs in India quite frequently. It has been noticed on gross in 81.4% cases. To start with in 2nd decade it goes on increasing till upto 4th decade where more or less 100% cases have atherosclerosis—an observation identical to the findings of others. The extent of the lesion i.e. percentage of the surface involved was more or less the same as reported earlier for Indian population or for Cali and Columbia. On the other hand the extent of lesion differed from that in Japan and Jamaica where 100% surface involvement was seen in 6th decade.

Fatty streaks are fairly common in Indians but the process of development of fibrous plaque is a slow and incidious process. Another difference observed in the present study was the occurrence of significant atherosclerotic lesion (fibrous plaque) late in 2nd decade as compared to the observations made by Gore et al. for the population of Japan and U.S.A. where the disease process can start earlier in 1st decade.

The complicated lesions are less frequent in the Indian population as was observed in the present study and also reported earlier. However, the salient difference in the present series from other workers was the appearance of calcified lesions in 3rd decade.
though involving a small portion of the intimal surface. Thus complicated lesions can occur in 3rd decade as in U.S.A. but the surface involved was 7% only as opposed to 40%. This difference in the pattern of atherosclerosis in Indians and white population might be responsible for the marked difference of myocardial infarction in the two countries i.e. 7.9% in the present study as opposed to 25% in Americans.

The other interesting feature observed was marked degree of disparity about the severity of the lesion between coronary arteries and root of the aorta. In case No.107 where both the coronary arteries were lead pipe type (Fig.2) aorta showed only fatty streaks whereas in case No.102 where aorta was more or less completely calcified and ulcerated the coronary arteries showed streaks and plaques only.

Presence of degenerative changes in the fibrous plaque was a salient feature in the present study. Calcification was present in 19.4% cases in LCA and 12.03% in RCA. This frequency was comparatively high to the observations of Chandra (6%) but Morgan has reported the presence of calcium in as many as 46.9% cases below the age of 50 years and in 60.6% above 70 years. Haemorrhage and thrombosis was seen in a few cases and that may be responsible for lower incidence of myocardial infarction in Indians. Goodale et al. have also reported lower incidence of thrombotic phenomenon in Africans as compared to white persons. Diffuse intimal thickening as observed in the present series and reported by other Indian workers may further be a contributory factor for lower incidence of myocardial infarction as chances of coronary occlusion are less in this type of lesion.

Problem of atherosclerosis is still unsettled. Though much work has been done about the etiopathogenesis of the disease but still there are many gaps in our knowledge of atheroma regarding its cause and structure of lesion and how far the lesions in the form of fatty streaks are related to the sclerotic ones. Benditt has reviewed the monoclonal nature of human atherosclerotic plaque and in eighty percent the plaques are of single phenotype. Such proliferation of cells to form plaque may be caused by mutagens which are chemical mutagens, viruses and radiation etc.

The variation in the frequency and severity of the atherosclerotic lesions between Indians and Western population could be due to the differences in the total lipid intake in the diet, amount of saturated and unsaturated fatty acids consumed, racial and hereditary factors, the phenomenon of stress and civilization, metabolic disorders, social customs like smoking, prevalence of thrombosis or fibrin deposition in intima and some unexplained reasons which may provide a further scope for workers to explore them.

Acknowledgement
The authors are extremely grateful to the Medical Department, Government of Uttar Pradesh, for the permission to use the post-mortem material in the present study.

REFERENCES


