RESEARCH ARTICLE

# ATHEROSCLEROSIS OF AORTA - AN AUTOPSY STUDY

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**ABSTRACT**

**Background and Objectives:** Atherosclerosis is a complex and common disease contributing to increased mortality and morbidity. The exact global incidence of atherosclerosis is beyond calculation. Autopsy studies can provide information about the impact and course of atherosclerosis. Present study is undertaken to study the spectrum and distribution of atherosclerotic lesions in the aorta and the association of age, sex, diet, socio-economic status, smoking and alcohol consuming habits with atherosclerosis.

**Methods:** Specimens of aorta up to its bifurcation were obtained from medico legal autopsies. Sections from representative areas were studied for gross and microscopic evidence of atherosclerosis.

**Results:** Among the 50 cases studied 35 were males and 15 were females. Aortas of 31 males (77.5%) and 9 females (27.27%) showed evidence of atherosclerosis. Males were affected more than females. Age has a dominant influence on atherosclerosis, it increased with age. 40 (80%) cases showed evidence of aortic atherosclerosis. Alcohol consumption and cigarette smoking trends have dominant role in acceleration of atherosclerotic lesions. Abdominal aorta was most commonly involved.

**Interpretation and Conclusion:** Autopsy studies play a vital role in unraveling the spectrum and occurrence of atherosclerosis. This study will help radiologists and surgeons to diagnose and treat abdominal vascular pathology. Atherosclerosis is a complex and multifactorial disease. The incidence of atherosclerosis in developing countries (like India) is same as developed countries.

**Keywords:** Autopsy, Atherosclerosis, Aortic atherosclerosis, Aorta.

## INTRODUCTION:

The disease atherosclerosis has great relevance today. Atherosclerosis is a distinctive form of arteriosceorosis known from ancient times. The terms 'athere' (meaning-porridge) and sclerotic (hardening or fibrosis) derived from Greek terminology, do not represent the complete morphology of disease. Despite our familiarity with this disease, some of its fundamental characteristics remain poorly recognized and understood. The cause and pathogenesis of atherosclerosis remains subject of lively speculation and controversy [1].

Atherosclerosis is a pathological entity and a multifactoid disease of large and medium sized arteries, characterized by plaque like intimal deposits which contain neutral fats, cholesterol, lipophages, blood elements, at times, other evidence of hemorrhage and calcium deposits. Complications of which are disastrous – ischaemic heart disease, cerebral stroke, peripheral gangrene and so on. It is a pandemic; percentage incidence of morbidity varies from country to country. It is a modern epidemic in U.S.A., Europe, Canada, New Zealand and Australia [2].

Among the diseases in the western world, atherosclerosis is overwhelmingly the prime disorder leading to death and serious morbidity [1]. The developing countries such as India, Singapore, Malaysia and Sri Lanka are catching up and registering a steady increase in the mortality rates due to atherosclerotic heart diseases [3]. In India coronary heart disease accounts for 10-15% of all cardiovascular diseases [4].

The exact global incidence of atherosclerosis is impossible to calculate because it has asymptomatic cases, this can be diagnosed only if an autopsy is done, in all cases of death due to any cause. However, the magnitude of the problem can be assessed by looking at the mortality rates in different countries due to atherosclerotic heart disease. In a survey conducted in males in the 45 to 54 years age group [5], the mortality rates due to atherosclerotic heart disease in different countries are lowest in Japan (8%) and highest in Finland (41%). In U.K., U.S.A., and Canada the average mortality rate is 36%. The disease is increasing in countries undergoing industrialization [6].

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In India there are no statistics giving the national incidence of this disorder [3]. However, Padmavathi and associates [7] gave the average incidence of atherosclerotic heart disease in seven different states during 1958-59 as 0.51% per 1,000 populations. In another autopsy study, atherogenic index as an indicator, the incidence of coronary heart disease is given as 35.5% in males and in females as 14% [5].

This study determine the severity and distribution of aortic atherosclerosis in the selected autopsies of the deaths occurring in general population of Chitradurga, Karnataka state, which has good representation of all social classes.

**METHODS:**

The material for the present study included thoracic aorta and abdominal aorta up to its bifurcation obtained from medico legal autopsies performed in the Department of Forensic Medicine, Basaveshwara medical college Hospital and Research Centre, Chitradurga,

The study was conducted on 50 (fifty) specimens of aorta, and relevant information including of the deceased were obtained from the informant accompanying the deceased.

The methods used for the analysis of the material was as per the procedure recommended by
1. White, Edward and Dry (1950) [17].
2. Gore and Tejada (1957) [18].
3. W.H.O. study group (Technical report series, 1958, 1962, 1964) [!3,14,15].

**Examination of Aortic lesions:**

The heart with aorta down to its bifurcation into the common iliac arteries was removed from the body by standard procedures. The aorta was opened longitudinally by slitting with scissors along with the anterior edge, after first stripping the adventitial fat and other adherent tissues. The intimal surface was washed free of blood and inspected with naked eye and with the help of a hand lens to detect the presence of atherosclerotic lesions which were graded in the fresh state. In accordance with the recommendations of the WHO [15] study group the lesions were classified morphologically as:

**Grade – I**: Fatty streaks or spots; any intimal lesion that is a fatty spot or streak, which will be distinct from other surrounding area.

**Grade – II**: Fibrous plaque; is firm, elevated intimal lesion which is in the fresh state pale grey, glisteing and translucent.

**Grade – III**: Atheroma; A variable combination of change of the intima of arteries, consisting of focal accumulation of lipid complex, carbohydrates, blood and blood products, fibrous tissue, calcium deposits and associated medial changes.

**Grade – IV**: Complicated lesions; those areas in which there is ulceration, hemorrhage or thrombosis with or without calcium deposits.

The quantitative assessment of the intimal lesions has been done by the methods of Gore and Tejada (1957) [18]. The quantitative visual assessment of intimal lesions is done by estimating the total percentage of the intimal surface involved with all types of the atherosclerotic lesions in each areas of the full length of aorta. Depending on the percentage of involved surface area due to each of the four different types of atherosclerotic lesions, aorta was divided into five groups, 0, A, B, C, D.

| Group | Proportion of intima diseased |
|-------|-------------------------------|
| O | less than 5% |
| A | 6 -15% |
| B | 16 – 33% |
| C | 34 – 50% |
| D | More than 50% |

**RESULTS:**

Youngest subject was 19 years and the oldest was a male of 80 year age, forming a age range of 19-80 years. The majority of the cases were from 3rd to 4th decades of life forming 58% of total number of cases studied. There were 35 males and 15 females in the ratio of 2.5:1.

Among the fifty cases studied 40 cases showed aortic atherosclerosis.

It was observed that all the cases which showed aortic atherosclerosis showed evidence of coronary atherosclerosis and it also shows that aortic atherosclerosis is more than coronary atherosclerosis.

**Table 4: Smoking and Atherosclerosis**

| Habit of Smoking | No. of cases | Positive cases | |
|---|---|---|---|
| | | No. of cases | Percentage |
| Smokers | 24 | 19 | 79.16 |
| Non-smokers | 26 | 14 | 53.84 |
| Total | 50 | 33 | - |

The above table showed higher incidence in smokers (79.16%). When compared to non-smokers (53.84%).

**Table 5: Alcoholism and atherosclerosis**

| Alcoholism and habit | No. of cases | Positive cases | |
|---|---|---|---|
| | | No. of cases | Percentage |
| Alcoholics | 23 | 18 | 78.26 |
| Non-alcoholics | 27 | 15 | 55.55 |
| Total | 50 | 33 | - |

Incidence of atherosclerosis was greater in alcoholics (78.26%) than in non-alcoholics (55.55%).

**Table 6: Aortic Atherosclerosis**

| Age group | Sex | Total No. of cases | No. of positive cases | Total positive | Percentage |
|---|---|---|---|---|---|
| 11-20 | Male | 2 | 1 | 1 | 25 |
| | Female | 2 | 0 | | |
| 21-30 | Male | 6 | 5 | 6 | 75 |
| | Female | 2 | 1 | | |
| 31-40 | Male | 12 | 10 | 12 | 70.58 |
| | Female | 5 | 2 | | |
| 41-50 | Male | 8 | 8 | 12 | 100 |
| | Female | 4 | 4 | | |
| 51-60 | Male | 5 | 5 | 6 | 100 |
| | Female | 1 | 1 | | |
| 61-70 | Male | 1 | 1 | 2 | 100 |
| | Female | 1 | 1 | | |
| 70 and above | Male | 1 | 1 | 1 | 100 |
| | Female | 0 | 0 | | |
| | | 50 | 40 | 40/50 | 80 |

Of the 50 cases studied 40 cases showed aortic atherosclerosis. This table shows that aortic atherosclerosis will increase with age and it also shows that males are more affected i.e., 31 cases (77.5%) than females in 9 cases (22.5%).
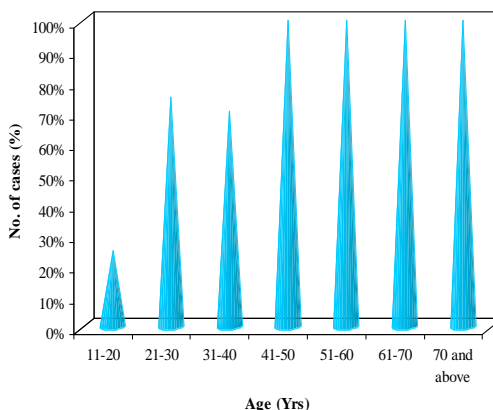
**Graph 1: Aortic Atherosclerosis**



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**Figure 1: Aortas with different types of atherosclerotic lesions**

### Salient features of atherosclerotic lesions:

Histological examination of representative plaques in the second and third decades showed the presence of fat with little or no cellular reaction. In the 4th and 5th decades, there was generally a fibrous tissue reaction to the presence of fat. By the 5th decade, the fibrous reaction had become more pronounced and was associated with degenerative changes.
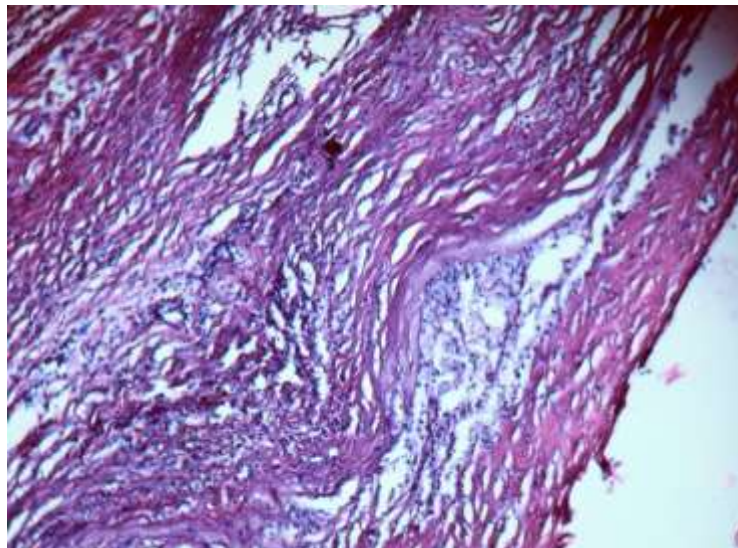


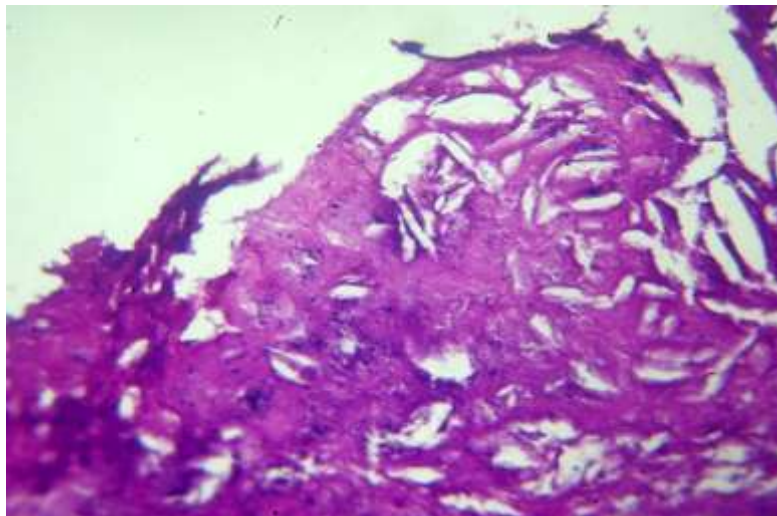**Figure 2: Aorta-grade III atherosclerosis with foamy macrophages (H&E x 50)**



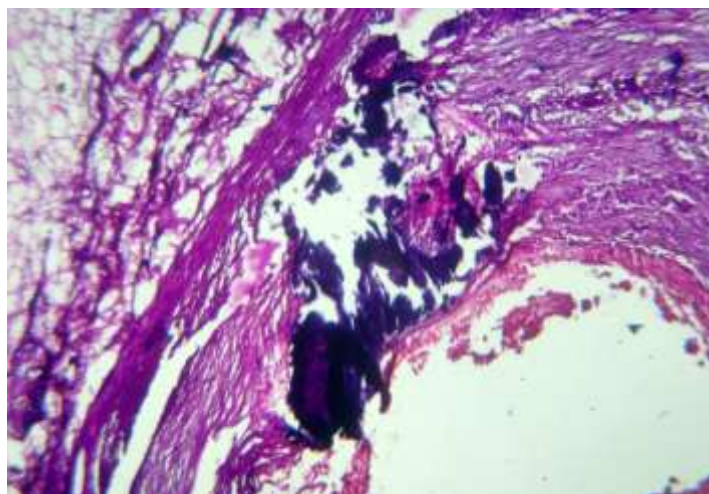**Figure 3: Aorta-Athermanous plaque with cholesterol clefts (H&E x 100)**

Figure 4: Aorta-grade IV type of atherosclerosis with calcification (H&E x 50)

## DISCUSSION:

The autopsy study provides a means of understanding the basic process which sets a stage for clinically significant atherosclerotic cardiovascular disease, as there is no valid method of sampling the living population. It was, therefore, considered that deaths suspected due to cardiovascular pathology, probably provide the best sample of the living population for studying atherosclerosis. Many epidemiological studies have brought to light a number of factors that are of indisputable importance in the development of atherosclerosis.

Table 9: Percentage incidence of atherosclerosis in various studies

|   | Study | Place | Percentage |
|---|---|---|---|
| 1. | Enos et al., (1953) [18]. | Korea | 77.3 |
| 2. | Wig and associates (1962) [8]. | North India | 64 |
| 3. | Subramaniam R. et al., (1964) [10]. | Madras | 62 |
| 4. | Bhargava and Bhargavan (1975) [11]. | North Karnataka | 69.9 |
| 5. | Shirani J et al., (1995) [20]. | USA | 65 |
| 6. | Strong J.P. et al., (1999) [12]. | USA | 60-80 |
| 7. | McGill et al., (2000) [16]. | USA | 58 |
| 8. | Present Study | Chitradurga (India) | 66 |

The percentage incidence of atherosclerosis in various studies ranged from 58% in the study by Mc Gill et al., in United States to 77.3% by Enos et al., among soldiers killed in action in Korea. In present study, the incidence was 66% which was almost comparable to all studies and nearly equal to Wig and Associates, Shirani J et al., studies.

Table 10: Shows age range in different studies in comparison with the present study

|   | Study | Age range |
|---|---|---|
| 1. | Enos et al., (1953) [19]. | 18-48 |
| 2. | Wig and Associates, (1962) [8]. | 0-80 |
| 3. | Subramaniam R. et al., (1964) [10]. | 2½ -94 |
| 4. | Bhargavan and Bhargava, (1975)[11]. | 0-90 |
| 5. | Shirani J. et al., (1995) [20]. | 71-80 |
| 6. | Strong J.P. et al., (1999) [12]. | 15-36 |
| 7. | McGill et al., (2000) [16]. | 15-34 |
| 8. | Present study | 19-80 |

The age group in above studies varied from neonates to 94 years, whereas in the present study, it was 19 to 80 years. The minimal age was almost equal to Enos et al., Strong J.P. et al., and McGill et al. The maximal age was similar to Wig and Associates and Shirani J. et al.

After fifth decade almost all the cases in the present study showed the evidence of atherosclerosis. The present study was almost comparable to the above studies in the remaining decades.

Of the 50 aortas studied, 40 showed atherosclerotic lesions of varying severity. The results obtained from this study indicate that atherosclerosis in the aorta progresses with advancing age. In India, Mathur (1961) [9], Bhargava (1975) [11] found atherosclerotic lesions in the aorta in the first decade of life itself, and this constituted the best evidence for the contention that atherosclerosis is not a disease of senescence.

In the present study, aortic atherosclerosis was first observed in the second decade of life following which almost all aortas showed some evidence of atherosclerosis. Subramaniam et al (1967) [10] also noted that aortic atherosclerosis first commenced in the second decade of life. Increase, in the extent of intimal surface involved and the severity of lesions were gradual in the second and third decades, but rapid thereafter. Fatty streaks were predominant lesions during those two decades. The peak incidence of fatty streaks in the aorta was seen in the third decade following which there was a decline. Mathur (1961) [9] observed that this decline could be due to their conversion into fibrous plaques and not necessarily due to their regression.

In this study raised lesions and complicated lesions showing calcification, ulceration and hemorrhage were found with the greatest frequency in the lower two thirds of the abdominal aorta.

The difference in severity of aortic atherosclerosis between males and females were apparent from the second decade of life and were especially marked up to the 4th decade when the difference tended to diminish, owing to a steep rise in the severity of lesions in females from 5th decade onwards. The underlying cause for this predominance of atherosclerosis in males over females may be in some inborn basic differences between the two sexes, such as the generally more rapid metabolism in the males, structural, hormonal and social differences have also been considered in explaining this discrepancy by Mathur (1961) [9].

Concerning the relationship of coronary atherosclerosis to aortic atherosclerosis, it was seen that in the majority of the cases the severity of coronary atherosclerosis could be correlated with severity of aortic lesions. However, in some cases a disparity was seen between these lesions. It was seen that a few subjects with severely diseased aortas had only mild lesions in the coronaries. In few others coronary lesions were associated with only a moderate degree of aortic atherosclerosis.

**CONCLUSION:**

Autopsy study is the most useful measure of the epidemiology of atherosclerosis. It was observed that all the cases which showed aortic atherosclerosis showed evidence of coronary atherosclerosis and it also shows that aortic atherosclerosis is more than coronary atherosclerosis. Abdominal aorta was most commonly involved. This study will help radiologists and surgeons to diagnose and treat abdominal vascular pathology, like angina and ischemia of abdominal viscera.

Atherosclerosis is a complex and multifactorial disease. Age has a dominant influence. Males are affected more than females. Smoking and alcoholism can accelerate the development of atherosclerotic lesions, though they are not atherogenic on their own.

All the observation in the present study showed that the incidence of atherosclerosis in the developing countries like (India) is same as developed countries.

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