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## Prevalence and distribution of atherosclerosis in different age groups in Tirupati area AP- Autopsy based study

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### Abstract

Atherosclerosis is the disease of the Arteries and specific form of arteriosclerosis, affecting primarily the intima of large and medium sized muscular arteries, characterised by formation of fibro fatty plaques and usually the inner lining of the artery is affected. Fatty materials deposit on the lining of the artery, forming a larger and larger mass which is called a plaque, causes more difficult for blood to flow through the artery, eventually the artery may close completely. If the plaque forms in an artery, it may block the flow of blood to the heart and leads to heart attack, if the plaque blocks in cerebral arteries it results a stroke and it can occur anywhere in the body. The Study is prospective and one Hundred hearts and aortas are examined from the different age groups of males and females, during the medico legal Autopsies. The study showed significantly the higher proportion of atherosclerosis in males than females and prevalence rate is increased as the age is increased and significant lesions are seen in chronic smokers, alcoholics and in non vegetarians.

**Keywords:** Atherosclerosis, Atheroma's, Arteriosclerosis.

### 1. Introduction

Atherosclerosis is a disease of large and medium-sized muscular arteries and is characterized by endothelial dysfunction, vascular inflammation and the build-up of lipids, cholesterol, calcium and cellular debris within the intima of the vessel wall. This build up results in plaque formation, vascular remodelling, acute and chronic luminal obstruction, abnormalities of blood flow and diminished oxygen supply to target organs.

Initially Fatty streaks develop as circulating monocytes, migrate into intima, take-up oxidized low-density lipo protein from the plasma and become lipid laden foam cells. When foam cells die and release their contents, extra cellular lipid pools appear. Smooth muscle cells migrate and proliferate within the plaque. As the lesion grows it encroaches into the lumen of the vessel and erodes the media. A mature fibro lipid plaque has a core of extra cellular lipid, surrounded by smooth muscle cells and is separated from the lumen by a thick cap of collagen rich fibrous tissue. Such plaques may rupture -allowing blood to enter and disrupt the arterial wall. This may compromise the lumen of the vessel and often precipitates in thrombosis and local vasospasm. Plaque rupture may lead to rapid growth of the lesion (or) occlusion of the vessel. Peak incidence of Atheroma was seen in between 29 and 44 years of age<sup>[17]</sup>. Coronary artery fatty streaks, very likely the progenitors of progressive Atheromata, usually begin to appear in vulnerable population by 10 years age. Smoking is considered as an important risk factor for Atherosclerosis<sup>[14]</sup>. Smoking alone was not responsible for coronary stenosis and myocardial infarction, People taking alcohol on sixteen or more days for a month had more extensive atherosclerosis in the aorta than those drinking on not more than three days a month. This difference was most significant in the case of calcified lesions.

Theories of Atherosclerosis are genesis, encrustation theory, Lipid theory and response-to-endothelial injury theory.

The endothelial injury suggests that the plaque formations are 2 types.

(1) Positive remodeling- an outward compensatory remodeling in which the arterial wall bulges outward and the lumen remains uncompromised. (2) Negative remodeling- The Lesions exhibit almost no compensatory vascular dilation and the atheroma steadily grows inward, causing gradual luminal narrowing.

When plaque ruptures the cells that accumulate at site and thrombosis produces the cytokine interferon gamma, which inhibits collagen synthesis, already formed collagen is degraded by macrophages that produce proteolytic enzymes and by matrix metalloproteinase (MMPS), particularly MMP-1, MMP-13, MMP-3 and MMP-9. The MMPS are induced by macrophages and SMC- derived cytokines such as IL-1, tumor necrosis factor (TNF), and CD154 or TNF-alpha.

Histopathology of atherosclerotic lesions - New concept <sup>[15]</sup>

1. Stary I Lesion: The endothelium surface adhesion molecules E selection and P selection, attracting more polymorphonuclear cells and monocytes in the sub endothelial space.
2. Stary II Lesion: Macrophages begin to make up large amounts of LDL (fatty streak).
3. Stary III Lesion: As the process continues, macrophages eventually become foam cells.
4. Stary IV Lesion: Lipid exudes into the extra cellular space and begins to coalesce to form the lipid core.
5. Stary V Lesion: SMCs and fibroblasts move in, forming fibro atheromas with soft inner lipid cores and outer fibrous caps.
6. Stary VI Lesion: Rupture of the fibrous cap with resultant thrombosis causes ACS.
7. Stary VII and VIII Lesions: As lesions stabilize may become fibro calcific (Stary VII lesion) and ultimately, fibrotic with extensive collagen content (Stary VIII lesion).

**2. Material & Methods**

To study the prevalence of Atherosclerosis in autopsy cases, Specimen (heart and aorta) were collected from 100 medico legal autopsies. They were fixed in 10% formalin solution. The aorta was separated from the heart. Sudan stain was poured over the gross lesions and kept for 5-10 minutes. Then they were washed to see the fat staining. Representative sections are given from the areas for histopathological study. The heart was isolated and dissected with enterotome as per standard procedure i.e. in the direction of blood flow. Coronary arteries were dissected transversely by sharp knife as well as longitudinally up to its Ostia, and the morphological lesions were plotted in proforma. Left coronary artery and its branch such as circumflex, right coronary artery are sectioned and studied with histopathological examination. Tissues thus selected were subjected to automatic processing: blocks were

made out of 6-8 microns and stained with hematoxylin, Eosin and Special stains were employed- Elastic stain, Toluidine blue, Sudan III stain. The bits are subjected for Histopathology examination. The grossing and automatic processing, block making and reporting was done in the Dept of Pathology, S.V. Medical College, Tirupati.

**3. Findings**

One hundred cases of random fresh bodies, those which came for post mortem examination during the period of one year are taken for the study. The study is prospective and has included the deceased who have been autopsied in the S.V. Medical College, Mortuary, Tirupati. It has included proximal part of right coronary artery, left coronary artery, circumflex artery, thoracic and abdominal aorta. Based on a grading system that takes into an account both the area of most severe involvement and total extent of intimal involvement.

The gross examination lesions are dissected and subjected for histopathological examination. The results are statistically analysed. The age, sex and disease distribution of patients were evaluated by means of the Chi-square ( $\chi^2$ ) and Fisher exact probability tests, both of which compare the proportions of cases falling into various categories in one group with the proportions of cases falling into the same categories in another group. The Chi-square ( $\chi^2$ ) test was applied to those groups, which contained more than 40 patients, and Fisher test was employed when smaller groups were involved.

The probability level of significance for these entire statistical test was arbitrarily set as P=0.01. In the present study it was observed that overall there are 70% males and 30% of females groups are present. Higher proportional of males belonged to higher age groups are compared to that of females. The proportion of atherosclerosis is found to increase with age being lowest in 10-19 years of age group (78.6%) and highest in 60 and above age group were 100%. The results are shown in various tables.

**Table 1:** Age and Sex distribution their Percentages and Statistical Significance

Age group (years)	Male (70) (%)	Female (30) (%)	Total (100)	Statistical significance
10-19	4 (5.7)	10 (33.3)	14 (14.0)	$\chi^2= 17.31$ df=5 p=0.00395
20-29	14 (20.0)	4 (13.3)	18 (18.0)	
30-39	18 (25.8)	8 (26.8)	26 (26.0)	
40-49	12 (17.1)	4 (13.3)	16 (16.0)	
50-59	12 (17.1)	0 (0)	12 (12.0)	
60 & above	10 (14.3)	4 (13.3)	14 (14.0)	
Total	70 (100.0)	30 (100.0)	100 (100.0)	
Mean Age	40.67±15.22	33.43±18.05	38.50±16.52	T=2.32, p=0.022; S

Table 1: Higher proportion of males belonged to higher age groups compared to that in females. The mean age of male

subjects is comparatively higher than females. The age differences by sex are also statistically significant.

**Table 2:** Atherosclerosis changes by selected variables Based on Diet and Risk factors

S. No.	Variable	Atherosclerosis changes			Statistical significance
		Present (%)	Absent (%)	Total (%)	
1.		<b>Age group</b>			$\chi^2= 6.23$ df= 5 p= 0.28 NS
	10-19	11 (78.6)	3 (21.4)	14 (100.0)	
	20-29	15 (83.3)	3 (16.7)	18 (100.0)	
	30-39	22 (84.6)	4 (15.4)	26 (100.0)	
	40-49	15 (93.8)	1 (6.3)	16 (100.0)	
	50-59	12 (100.0)	0 (0.0)	12 (100.0)	
	60 & Above	14 (100.0)	0 (6.7)	15 (100.0)	
	Total	89 (89.0)	11 (11.0)	100 (100.0)	
2.		<b>Sex</b>			$\chi^2=8.58$ P=0.0033,S
	Male	67 (95.7)	3 (4.3)	70 (100.0)	
	Female	22 (73.3)	8 (26.7)	30 (100.0)	

3.	<b>Diet</b>				Fisher exact test, P=0.22,NS
	Vegetarian	19 (82.6)	4 (17.4)	23 (100.0)	
	Non-vegetarian	70 (90.9)	7 (9.1)	77 (100.0)	
4.	<b>Smoking</b>				Fisher exact test, p value = 0.04,S
	Yes	24 (100.0)	0 (0.0)	24 (100.0)	
	No	65 (85.5)	11 (13.2)	76 (100.0)	
5.	<b>Alcoholism</b>				Fisher test p=0.046,S
	Yes	21 (100.0)	0 (0.0)	21 (100.0)	
	No	68 (86.1)	11 (13.9)	79 (100.0)	

Table 2: the proportion of atherosclerosis is found to increase with age, being lowest in 10-19 years age group (78.6%) and highest in 60 & above year's age group (100.0%). The differences were also statistically significant. Significantly

higher proportion of atherosclerosis is found in males than females (95.7% Vs 73.3%), Smokers (100.0%) than non-smokers (100.00 vs. 85.5) and alcoholics (100.00 Vs 86.1)

**Table 3:** Overall Atherosclerotic changes by selected variables

S. No.	Variable	Total Subjects	Mean Level of atherosclerosis in all arteries examined	Statistical Significance
1.	<b>Age Group</b>			F=13.57 P<0.001; S
	10-19	14	0.78±1.12	
	20-29	18	1.61±1.71	
	30-39	26	1.99±1.62	
	40-49	16	2.31±1.33	
	50-59	12	3.25±2.01	
	> 60	14	5.05±1.13	
	Total	100	2.38±1.96	
2.	<b>Sex</b>			t=3.13 P=0.00023,S
	Male	70	2.77±1.83	
	Female	30	1.48±1.96	

Table 3: The degree of overall atherosclerosis in all arteries examined has shown a significant rise with age being lowest in 10-19 years age group (0.78) and highest in 60 & above year's

age group (5.05).Significantly higher degree of atherosclerosis is found with male sex (2.77)

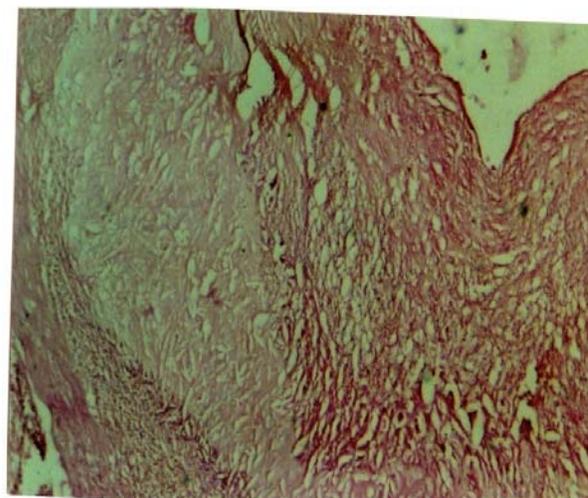
**Table 4:** Level of Atherosclerosis changes in various arteries examined

Level of athero- sclerosis	Artery examined & mean level of atherosclerosis					Statistical significance
	RCA	LCA	Circumflex	TA	AA	
0	41	40	55	38	26	χ <sup>2</sup> = 16.44 Df =12 P=0.0057; S
1	0	0	0	0	0	
2	25	26	18	27	30	
3	0	0	0	0	0	
4	5	3	3	3	1	
5	21	16	19	25	34	
6	6	5	1	0	2	
7	1	4	1	7	5	
8	1	6	3	0	2	
Total Atheros-sclerosis	59	60	45	62	74	

Table 4: The abdominal aorta is commonly affected by atherosclerosis (74%) compared to other arteries, being lowest in circumflex artery (45.0%). The differences between arteries are also statistically significant.



**Fig 1:** Aorta shows Atherosclerotic lesions with ulceration.



**Fig 2:** Atherosclerotic Plaque with cholesterol clefts (H&E Stain 10X)

#### 4. Discussion

For the study total one hundred samples are collected, out of hundred 70 are males and 30 are females. In addition to age factor, diet and behavioural characters, diseases like hypertension, diabetes are taken into consideration to know the grades of Atherosclerosis. In the study, among females, in 3<sup>rd</sup> decade 3.3% are having advanced lesions, who had habit of eating beef regularly. But there was significant involvement of Arteries with Atherosclerosis in the males than the females. In 60 and above age group the lesions were almost equal in both sex. As the age advanced the severity of Atherosclerosis increased correlating with the study of Autopsy studies in Atherosclerosis. Higher proportion of males belonged to higher age groups compared to that in females. The mean age of male subjects is comparatively higher than females. The age differences by sex are also statistically significant (Table 1). Dr. James and C. Robert<sup>[10]</sup> suggested that Arteriosclerosis increases with age and involves primarily in the larger arteries. The present study correlates with their study.

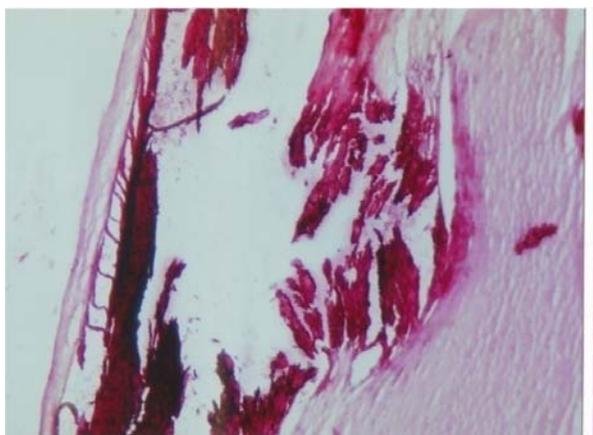


Fig 3: Atherosclerotic plaque with calcification (H&E Stain 10X)

The study by Roberts, Moses Wilkins<sup>[10]</sup> on men and women the right coronary artery and the anterior descending coronary artery generally contained the most severe coronary atherosclerosis and present study correlates with above study. As age advances, the severity of Atherosclerosis is also increased and this may lead to sudden death if the total artery is involved when the lumen is blocked. In thoracic aorta 100% lesions were seen in both sexes, correlating with Brit, Heart J. study<sup>[9]</sup> it is suggested that as age advances both the sexes are equally affected by atherosclerosis. As age advances Atheroma's and complicated lesions are present in the middle and older age groups. Significant lesions are seen in those had history of Diabetes mellitus and Hypertension.

Sex has no difference. Both sex were affected by Atherosclerosis from 2<sup>nd</sup> decade onwards. As the age advances the complicated lesions were seen in the arteries 60 and above age groups in both sexes correlates with the study by Dr. M. K.S. Reddy<sup>[11]</sup>.

The proportion of atherosclerosis is found to increase with age, being lowest in 10-19 years age group (78.6%) and highest in 60 & above year's age group (100.0%). The differences were also statistically significant. Significantly higher proportion of atherosclerosis is found in males than females (95.7% vs 73.3%), Smokers (100.0%) than non-smokers (100.00 vs 85.5) and alcoholics (100.00 vs 86.1) (Table 2)

The degree of overall atherosclerosis in all arteries examined has shown a significant rise with age being lowest in 10-19

years age group (0.78) and highest in 60& above year's age group (5.05). Significantly higher degree of atherosclerosis is found with male sex (2.77) (Table 3). The abdominal aorta is commonly affected by atherosclerosis (74%) compared to other arteries, being lowest in circumflex artery (45.0%). The differences between arteries are also statistically significant. (Table 4). In the present study positive lesions are seen at the age 14 in the females and at the age 18 in the males. As age advanced there was gradual raise of Atherosclerotic lesions. 60 and above age group had advanced complicated lesions in the present study. The study correlates with Dr. Sahoo's Study<sup>[8]</sup>. In addition, the males and the females are equally affected by atherosclerosis when the age advanced. The Males and the females more or less were affected below 50 years of age group and females were not exempted from Atherosclerosis. But there was significant involvement of Arteries with Atherosclerosis in the males than the females. Before the conclusion there is still a need for autopsy studies in the Investigation of risk factors and atherosclerotic lesions. The study comprises only one hundred cases, it reveals that much of the prevalence rate of atherosclerosis in this region. It may be taken as a sample study for further research work.

#### 5. Recommendations

Lifestyle change Modification, adequate exercise, eating a diet rich in fruits and vegetables and low in saturated fat, weight loss if obese. Diabetes, high blood pressure, abnormal cholesterol, obesity, elevated homocysteine and elevated risk of blood clots should be under control and periodical health checkups are recommended.

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