

A Study of Correlation of Common Carotid Intima-media Thickness with Smoking Status

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Abstract:

Introduction: Tobacco smoking is rapidly increasing global practice, which is a preventable risk factor in pathogenesis of coronary artery disease and cerebrovascular disease. Measurement of common carotid intima media thickness is a noninvasive method to assess subclinical atherosclerosis.

Objective

To assess the dose response relationship between cigarette smoking and carotid atherosclerosis and to compare the common carotid intima media thickness in current and ex-smokers to assess the benefits of quitting tobacco smoking.

Methods

Patients were divided into three groups current smokers, non smokers and ex-smokers. Exposure was calculated in cigarette pack years. In all patients body mass index, blood pressure, lipid profile and common carotid intima media thickness was measured. Statistical analysis was done using Chi square test .P value <0.05 was taken as significant and <0.01 was taken as highly significant. Intergroup comparison was done by ANOVA. comparison of various risk factors of carotid atherosclerosis was done using multiple logistic regression analysis.

Result

When the mean age, mean BMI, mean blood pressure was compared between three groups no significant difference was found. The values of serum total cholesterol, serum LDL were higher in the current and ex-smokers group (P=0.001)(p = 0.002), the values of serum HDL were lower in current and ex-smokers group the difference was statistically significant. Common carotid intima media thickness was found to have linear correlation with no of cigarette pack years.

Conclusion

There is a linear relationship between smoking exposure and common carotid intima media thickness in both current, smokers and ex-smokers. Amount of smoking exposure has positive correlation with common carotid intima media thickness where as smoking status does not have a correlation, over a short period of abstinence.

Introduction:

Tobacco smoking causes more than 5.4 million deaths per year, more than those caused by HIV/AIDS, tuberculosis, malaria combined. By 2030 death toll will increase to 8 million per years.¹ Unless urgent action is taken tobacco is expected to kill one billion people during this century^{1,2}

Cigarette smoking is associated with various diseases like coronary artery disease, aortic aneurysms, lung cancer, carcinoma bladder and low birth weight in infants of female smokers. Amongst these the coronary artery disease and cerebro-vascular disease is directly related to atherogenic effect of cigarette smoking³

Measurement of carotid intima media thickness of the common carotid artery by ultrasonography is a noninvasive and quantitative method of evaluating early atherosclerotic changes in the vasculature^{4,5,6} cigarette smoking has cumulative effect on atherogenesis with increase in smoking exposure in terms of cigarette pack years. Smokers die approximately 10 years before nonsmoker and smokers are almost three times more likely to die in the middle age as compared to nonsmokers⁷

Smoking cessation at an earlier age is an important tool for improving the long term prognosis of coronary artery disease and stroke⁸

Hence this study was carried out to determine the extent to which quantity of smoking effects the process of atherosclerosis and to what extent smoking cessation contributes to the changes in the atherosclerotic vasculature by measuring common carotid intima media thickness and comparing it between current smokers and ex-smokers.

Objective

This study was carried out with the objective of knowing the effect of dose and duration of smoking on common carotid artery intima, media thickness and to compare it between current and former smokers.

Methodology:

This study was carried out for 2 years from February 2007 to February 2009. It included 50 current smokers, 50 ex-smokers, 50 controls in the 40-60 age group. All patients were male as no female smokers were found. Smoking exposure was calculated in cigarette pack years

$$\text{Pack years} = \frac{\text{No. of Cigarettes per day} \times \text{No. of years of smoking}}{20}$$

Current smokers were defined as those who had at least 1 pack year of cigarette smoking exposure. Ex-smokers were defined as those who have at least 1 pack year of cigarette smoking exposure and abstained from smoking at least six months prior to the interview^{3,10,11}

Non Smokers were defined as those who have never smoked in their life time and for whom exposure to environmental tobacco smoke was not more than 1 hour per day in the form of passive smoking^{3,10,11}

Persons with multiple tobacco habits alcoholics,

patients of diabetes and of ischaemic heart disease, stroke, chronic kidney, liver disease and hypothyroidism were excluded. Patients who were on thiazide diuretics, hypolipidaemic agents and on B blockers were excluded.

Each participant underwent detailed clinical history, examination and investigations. Physical examination was performed to assess height, weight, body mass index and blood pressure. Body mass index was calculated by $(\text{Wt. in (Kg)} / (\text{Height in meters})^2)$

They were investigated for blood sugar lipid profile, ECG, and Carotid intima media thickness by colour Doppler ultra sound examination. Six separate measurements of maximum intima media thickness were obtained for the far wall of right and left common carotid artery and the mean of six measurement were recorded as the intima media thickness.

Statistical analysis:

The level of significance for comparison between group for various risk factor was done using chi square test, P value < 0.05 was taken as significant and < 0.01 was taken as highly significant. Intergroup comparison was done by ANOVA. Post hoc analysis was done by Scheff's test. Correlation co-efficient was calculated by Microsoft excel. Concurrent effect of cigarette pack years and smoking status on common carotid intima media thickness was studied using two way ANOVA. Comparison of various risk factors of carotid atherosclerosis was done using multiple logistic regression analysis.

Results:

Table 1 :Comparison of demographic and clinical characteristics between three groups

| S. N. | Parameter | Controls n= 50 | Current smokers n= 50 | Ex smoker n= 50 | |
|-------|-------------------------------|----------------|-----------------------|-----------------|---|
| 1 | Mean age in years | 49.82 ± 6.41 | 50.02 ± 6.784 | 8.36 ± 9.24 | df=9 p=0.9979(NS) x ² =1.386 |
| 2 | Mean BMI in Kg/m ² | 26.85 ± 3.802 | 6.43 ± 4.2725.9 | 3 ± 5.37 | df=6 p=0.9733(NS) x ² =1.270 |
| 3 | Mean Systolic Blood pressure | 124.80 ± 17.95 | 137.16 ± 20.30 | 134.6 ± 17.89 | P = 0.224 (NS) F=1.511 |
| 4 | Mean diastolic Blood Pressure | 79.88 ± 11.60 | 86.08 ± 11.27 | 86.2 ± 11.34 | P=0.608 (NS) F=0.500 (NS) |
| 5 | Presence of hypertension | 21 (42%) | 25 (50%) | 29 (58%) | |

| | | | | |
|---|---------------|---------------|---------------|---------------------------|
| 6 Non hypertensive Patients | 29 (58%) | 25 (50%) | 21 (42%) | |
| 7 Mean Total Cholesterol in(mg/dl) | 173.9 ± 32 | 198.8 ± 32.56 | 197.9 ± 41.70 | P=0.001* |
| 8 Mean serum triglycerides in (mg/dl) | 121.3 ± 37.24 | 130.6 ± 36.84 | 132.9 ± 32.05 | P = 0.168NS) |
| 9 Mean LDL in mg/dl | 107.7 ±29.41 | 138.5 ± 30.86 | 135.4 ± 39.15 | P = 0.002 Significant |
| 10 Mean HDL in (mg/dl) | 41.66 ± 5.30 | 35.82 ± 14.96 | 35.56 ± 5.75 | P < 0.001* Significant |
| * Statistically significant | | | | |
| LDL – Low density lipoprotein NS – Not Significant HDL – High density Lipoprotein | | | | |

Table 2
Common Carotid Intima Media Thickness in Controls, Current smokers and Ex-smokers

| | Controls N=50 | Current Smoker N=50 | Ex-smokers N=50 | P Value |
|--|------------------|------------------------|--------------------|---------|
| Common carotid intima media thickness in mm (mean ± SD)* | 0.7908 ± 0.1063 | 0.9724 ± 0.1631 | 0.9300 ± 0.1332 | < 0.001 |
| Percent with plaque positive status | 6% | 30% | 12% | P=0.003 |
| * Statistically significant | | | | |

Table 3
Effect of pack years on intima media thickness in current smokers and Ex-Smokers

| No. of cigarette pack years | Group | Mean | Std Deviation |
|-----------------------------|----------------------|------|---------------|
| 1-10 | Ex-smokers, n=21 | 0.8 | 0.683 |
| | Current smokers n=24 | 0.90 | 0.16 |
| 11-20 | Ex-smokers, n=11 | 0.91 | 0.05 |
| | Current smokers n=9 | 0.96 | 0.13 |
| 21-30 | Ex-smokers, n=10 | 1.01 | 0.11 |
| | Current smokers n=9 | 1.04 | 0.12 |
| 31-40 | Ex-smokers, n=4 | 1.05 | 0.10 |
| | Current smokers n=5 | 1.05 | 0.17 |
| ≥41 | Ex-smokers, n=4 | 0.93 | 0.13 |
| | Current smokers n=3 | 0.97 | 0.16 |

Table 4
Multivariate analysis of Factor influencing intima media thickness

| Risk Factor | P Value | β (beta adjusted odds) | Std. error |
|----------------------|---------|------------------------|------------|
| Age | 0.399 | 0.00 | 0.001 |
| Hypertension | 0.452 | 0.003 | 0.18 |
| BMI | 0.318 | 0.00 | 0.002 |
| Dyslipidaemia | <0.001 | 0.07 | 0.024 |
| Smoking Status | < 0.001 | 0.035 | 0.13 |
| Cigarette pack years | <0.001 | 0.21 | 0.001 |

Discussion :

The purpose of our study was to define the dose relationship between smoking exposure and carotid atherosclerosis and to compare the effect of smoking cessation on common carotid intima media thickness (CIMT). We have also studied the correlation between various risk factors for atherosclerosis like age, obesity, hypertension, and dyslipidaemia.

There are many factors that influence common carotid intima media thickness. The influence of age, body mass index, hypertension, dyslipidaemia, smoking status and smoking exposure was studied using multivariate analysis. Carotid atherosclerosis is directly associated with increase in smoking exposure. This relation was studied by correlation of common carotid intima media thickness and cigarette pack years. Current smokers and ex-smokers were compared after controlling for cigarette pack years. This was done to evaluate the effect of smoking cessation on common carotid intima media thickness. Majority of investigators^(9,12,13) selected relatively younger age group as is done in our study to minimize the effect of age on common carotid artery intima media thickness (CIMT). To nullify the effect of BMI (Body mass index) on CIMT participants with comparable BMI was taken as in other studies^(9,12,13). The mean systolic and diastolic Blood pressure in the ex-smokers, current smokers and controls were found to have no significant difference. Venkatesan A, Hemlatha A et al¹⁴ Studied plasma level of fasting cholesterol. They have found that levels of total cholesterol LDL, Non HDL cholesterol were significantly elevated when compared with controls.

In our study we have found increased total cholesterol, increased LDL and decreased HDL. This pattern of dyslipidaemia was consistent with the findings of other investigators who studied correlation of cigarette smoking with lipid profile^(9,12,13).

However hypertriglyceridaemia which is common lipid abnormality seen in smokers was not observed in significant difference as compared to the control group. This could partly be due to population specific variation.

In the present study we have found a linear relationship between smoking exposure in cigarette pack years and common carotid intima media thickness, CIMT increased with the increase in cigarette pack years. A

0.07 unit change in cigarette pack years caused 1 unit change in common carotid intima media thickness.

Other investigators Lloyd E Chambless et al¹⁵ and G.S. Tell, J.E. Polak et al have found¹⁶ similar relationship with their studies.

In our study we did not find any significant difference between CIMT in ex-smokers versus current smokers after controlling for cigarette pack years. The mean duration of abstinence in the present study was 2.7 ± 3.5 years. The relatively short period of abstinence could be one of the contributory reasons for not observing statistically significant difference in the two groups.

Atherosclerosis progression appears to be largely related to the pack years of cigarette exposure and not to the present smoking status. These observations suggest that the effect of smoking on atherosclerosis progression may be cumulative, proportional to life time pack years of exposure perhaps irreversible. If this is true the primary benefit from quitting smoking on the progression of atherosclerosis would be to prevent further accumulation of exposure. Survival benefit of cigarette smoking cessation could be attributed to effects like reducing tendency for coronary spasm and decreased susceptibility to arrhythmia in patients with coronary artery disease¹⁶.

Multivariate analysis in this study revealed a statistically significant effect of dyslipidaemia, smoking status and cigarette pack years on common carotid intima media thickness. These significant factors explained 51% variation in common carotid artery intima media thickness.

Conclusion :

There is a linear relationship between smoking exposure in cigarette pack years and common carotid intima media thickness in both, current smokers and ex-smokers ($P < 0.001$). Common carotid intima media thickness increases with the increase in cigarette pack years.

Amount of smoking exposure (cigarette pack years) has positive correlation with common carotid intima media thickness, whereas smoking status (ex or current) does not have a correlation, over a shorter duration of abstinence ($P < 0.001$).

Common carotid intima media thickness increases with

the presence of dyslipidaemia i.e. Increase in total cholesterol, increased low density lipoprotein (LDL), decreased high density lipoprotein and duration of smoking exposure as measured by cigarette pack years.

Implications of study

As the extent of carotid atherosclerosis is proportional to life time pack years of smoking exposure, the effect of smoking on atherosclerosis progression may be cumulative and not reversible over shorter period of abstinence. If this is true the primary benefit from quitting smoking on the progression of atherosclerosis would be to prevent further accumulation of exposure and there should be active physician intervention to urge smokers to quit smoking early on, to reduce the risk of cardiovascular disease. Smoking cessation attempts should essentially be accompanied by positive life style changes, exercise and dietary modification.

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