

ORIGINAL RESEARCH

A Cross-Sectional Study to Assess the Effects of Smoking on Common Carotid Intima-Media Thickness and Resistivity Index Among Current Smokers

¹Dr. Navya Singhal, ²Dr. Pulomza, ³Dr. Isha Juneja, ⁴Dr. Kirti Shekhawat, ⁵Dr. Nipa Hathila

^{1,2,3}Third year Resident, Department of Radiodiagnosis, Pacific Medical College and Hospital, Rajasthan, India

⁴Second year Resident, Department of Radiodiagnosis, Pacific Medical College and Hospital, Rajasthan, India

⁵Professor, Department of Radiodiagnosis, Pacific Medical College, Udaipur, Rajasthan, India

Corresponding Author

Dr. Kirti Shekhawat

Second year Resident, Department of Radiodiagnosis, Pacific Medical College and Hospital, Rajasthan, India

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ABSTRACT

Background: The present study was conducted for assessing the effects of smoking on common carotid intima-media thickness and resistivity index among current smokers. **Materials & methods:** A total of 100 current smokers and 100 non-smokers were enrolled in the current research. Current smokers were defined as subjects who had smoked within the previous 30 days and/or had smoked 100 cigarettes in his or her lifetime. Any CIMT thickness over 0.8 mm was regarded as abnormal. A localized protrusion of the vessel wall that expanded into the lumen by ≥ 1.5 mm was identified as the plaque. Bilateral CIMT and RI values were acquired. The RI was calculated according to Pourcelot equation. All the results were recorded in Microsoft excel sheet followed by statistical analysis using SPSS software. **Results:** Mean CIMT value among current smokers and non-smokers was 0.655 and 0.545 respectively. Mean CIMT values of smokers was found to be significantly raised in comparison to that of non-smokers. Mean RI value among smokers and non-smokers was 0.725 and 0.73 respectively. On comparing, the results were found to be statistically significant. **Conclusion:** Smoking leads to morphological alteration in CCA as depicted by altered CIMT.

Key words: Smoking, Carotid Intima-Media, Resistivity index

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INTRODUCTION

Tobacco consumption is the single most preventable cause of death and disability across the globe. In 2010, WHO estimated that 4.9 million premature deaths per year are attributable to tobacco use, mostly in the form of smoking. This number rose to 7.1 million in 2016, and is expected to reach eight million by 2030 if the current rate of tobacco consumption is unchanged.¹⁻³ India is the second most populous country in the world. India is the third largest producer and consumer of tobacco in the world. The country has a long history of tobacco use. Tobacco is used in a variety of ways in India; its use has unfortunately been well recognized.^{4,5}

Intimo-medial thickness (IMT) is a measure of the combined thickness of intima and media layers of carotid artery, most commonly assessed by B-mode ultrasound. Increase in carotid intima-media thickness (CIMT) may result from hypertrophy of intimal or medial layers or both because cellular/molecular

mechanisms that increase CIMT are also the factors responsible for development and progression of atherosclerosis.⁶ The resistive index (RI) test is a measure of impedance to blood flow and is done to measure subclinical atherosclerosis in the carotid arteries. A study compared RI and CIMT progression over a period of 6 years and found CIMT to be a better modality in the detection and assessment of subclinical atherosclerosis.⁷ Hence; the present study was conducted for assessing the effects of smoking on common carotid intima-media thickness and resistivity index among current smokers.

MATERIALS & METHODS

The present study was conducted for assessing the effects of smoking on common carotid intima-media thickness and resistivity index among current smokers. A total of 100 current smokers and 100 non-smokers were enrolled in the current research. Current smokers were defined as subjects who had smoked

within the previous 30 days and/or had smoked 100 cigarettes in his or her lifetime. Any CIMT thickness over 0.8 mm was regarded as abnormal. A localized protrusion of the vessel wall that expanded into the lumen by ≥ 1.5 mm was identified as the plaque. Bilateral CIMT and RI values were acquired. Transverse views of bilateral CCAs were initially inspected, working from the origin to the vessel bifurcation. For both CCAs, color Doppler was used with a sample volume that was roughly half of the vascular diameter and a Doppler angle ranging from 45° to 60°. The ideal setting for the color increase was when the color barely touched the inside surface of the vessel. The identical artery segment used for the CIMT measurements was also used for the spectral Doppler tracings. The RI was calculated according to

Pourcelot equation. All the results were recorded in Microsoft excel sheet followed by statistical analysis using SPSS software. Student t test used for evaluation of level of significance.

RESULTS

Mean age of the patients of CIMT group was 45.8 years and 47.1 years respectively. Majority proportion of patients of both the study groups were males. Mean CIMT value among current smokers and non-smokers was 0.655 and 0.545 respectively. Mean CIMT values of smokers was found to be significantly raised in comparison to that of non-smokers. Mean RI value among smokers and non-smokers was 0.725 and 0.73 respectively. On comparing, the results were found to be statistically significant.

Table 1: Comparison of CIMT (in mm)

CIMT (mm)	Current smokers	Non-smokers	p-value
Right	0.65	0.55	0.00*
Left	0.66	0.54	0.00*
Mean	0.655	0.545	0.00*

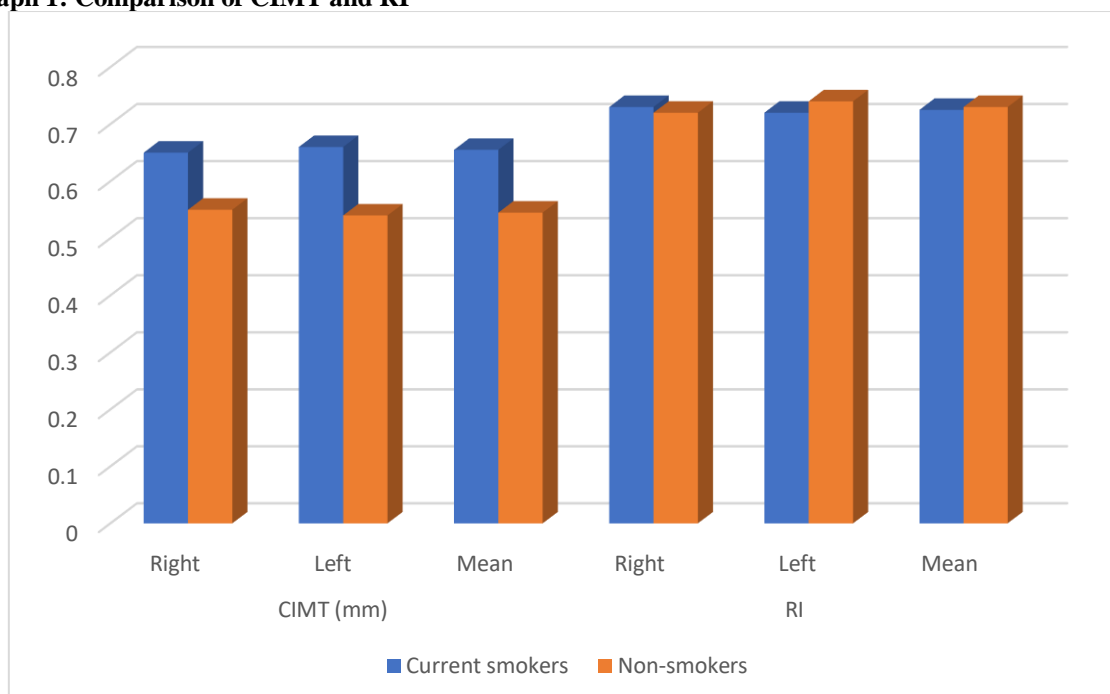
*: Significant

Table 2: Comparison of RI

RI	Current smokers	Non-smokers	p-value
Right	0.73	0.72	0.12
Left	0.72	0.74	0.27
Mean	0.725	0.73	0.88

*: Significant

Graph 1: Comparison of CIMT and RI



DISCUSSION

Tobacco consumption is the leading cause of the preventable deaths globally, killing about 6 million people annually around the globe. Global tobacco

epidemic kills more people than HIV, tuberculosis, and vector-borne diseases. India has a diverse population with the amalgamation of different cultures, religion, and practices. India's tobacco

problem is very complex with majority of people using variety of smoking forms and an array of smokeless tobacco (SLT) products. In country like India, the public spending on health is merely 1.04% of the gross domestic product. Thus, these financial constraints and economic burden to tackle mortality and morbidity related to tobacco can take a major hit on a low middle-income country like India.⁸Doppler ultrasonography is used to examine carotid arteries during a cardiac cycle. It assesses intima-media thickness (IMT), stenosis, plaques, and other lumen and wall alterations. This is a safe, affordable, reliable, repeatable, and convenient method to detect carotid atherosclerosis. The thickness between the intimal-luminal and the medial-adventitial interfaces is defined as the IMT or carotid intima-media thickness (CIMT). CIMT varies from 0.25 to 1.5 mm in healthy persons; levels over 1.0 mm are considered abnormal. Increased CIMT is associated with carotid atherosclerosis and is recognized as a risk factor for cardiovascular diseases. The arterial resistive index (RI) is related to both vascular resistance and compliance. Carotid artery RI is also an important indicator of carotid atherosclerosis and is related to cardiovascular diseases.⁹⁻¹¹ Hence; the present study was conducted for assessing the effects of smoking on common carotid intima-media thickness and resistivity index among current smokers.

Mean age of the patients of CIMT group was 45.8 years and 47.1 years respectively. Majority proportion of patients of both the study groups were males. Mean CIMT value among current smokers and non-smokers was 0.655 and 0.545 respectively. Mean CIMT values of smokers was found to be significantly raised in comparison to that of non-smokers. The effect occurrence in the intima media thickness (IMT) of the common carotid arteries, due to the number of cigarettes smoked per day in current smokers was studied in a previous study conducted by Mahmoud MZ et al. Carotids sonography brightness mode was performed using linear probe with a frequency of 7.5-10 MHz, all sonographic measurements of IMT were made in the longitudinal plane at the point of CCA along a 1 cm section of the artery distal to the carotid bulb. Significant, linear and positive correlation found between the numbers of cigarettes smoked per day and carotids mean IMT. Cigarette smoking is associated with carotid artery morphological changes caused due to significant impairment of the arteries endothelial function. This atherogenic effect led to variability of blood flow velocity inside the common carotid artery by increasing the peak systolic velocity (PSV) and decrease end diastolic velocity (EDV) in a proportional linear manner.¹²In another previous study conducted by Poredos P et al, authors evaluated the acute and chronic effects of smoking on endothelium-dependent (flow-mediated) dilation (FMD) of the peripheral arteries, the effects of dose and duration of chronic smoking on intima-media thickness (IMT) of the carotid arteries, and their interrelationship. The

study encompassed two groups of smokers. In group A there were 40 subjects of both sexes, who smoked on average 17.6 +/- 6.5 cigarettes per day, for 5 to 15 years (mean 8.95 +/- 4.0 years), mean age 28.1 years. Group B consisted of 42 smokers of both sexes who smoked 21.15 +/- 8.2 cigarettes/day for more than 15 years (mean 21.15 +/- 3.4 years), mean age 39.5 years. The control group consisted of 40 healthy subjects without major risk factors of atherosclerosis, mean age 29.1 years. Resting blood flow in the brachial arteries was significantly less in the smokers' groups than in controls. This decrease was much more evident in female than in male smokers. Female smokers also had significantly smaller brachial artery diameter at rest. In smokers the FMD of the brachial artery was reduced and the mean IMT was significantly greater than in controls.¹³

In the present study, mean RI value among smokers and non-smokers was 0.725 and 0.73 respectively. On comparing, the results were found to be statistically significant. The long-term associations between smoking habits, environmental tobacco smoke exposure (ETS), carotid intima-media thickness (IMT) progression rate, and rate of lumen diameter reduction in the carotid artery was studied in another previous study conducted by Hansen K et al. Former smokers showed distinct lowering of progression rates after more than five years since smoking cessation. Smoking and former smoking was associated with increased low-grade inflammation, however, the effect of smoking on atherosclerotic progression rate remained fairly unchanged after such adjustment. The effect of smoking and former smoking on carotid IMT progression rates and change in lumen reduction due to plaque protrusion could not be explained by differences in traditional risk factors or low-grade inflammation.¹⁴

CONCLUSION

Under the light of above obtained results, the authors conclude that smoking leads to morphological alteration in CCA as depicted by altered CIMT.

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