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RESEARCH ARTICLE

Comparative study of ankle-brachial pressure index in male smokers of Western India

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ABSTRACT

Background: Smoking is prevalent among the masses, yet the smokers are ignorant about the influence of smoking on peripheral arterial disease (PAD). Smoking is associated with atherosclerosis which in lower limb leads to PAD. The beginning stages of PAD are often asymptomatic, and early symptoms are often dismissed by subjects as "just leg pain." Identifying patients with asymptomatic PAD are essential to reduce morbidity and mortality. Ankle-brachial pressure index (ABPI) is a test, which can be used routinely to screen asymptomatic PAD patients. The cutoff value of ABPI <0.9 is used for its diagnosis. **Aims and Objectives:** The aim of the study was to compare the risk of PAD in male smokers and age-matched non-smokers of Western Indian. **Materials and Methods:** The present study included 121 asymptomatic male smokers and 121 asymptomatic male nonsmokers, between 20 and 40 years of age. Age, height, and weight were taken and body mass index was calculated from it. Blood pressure was taken by sphygmomanometer. By the help of handheld Doppler ultrasound, ABPI was calculated. **Results:** ABPI among smokers was less as compared to nonsmokers which decreases more as the severity of smoking increases. This denotes about the evolving PAD in asymptomatic smokers. The relative risk ratio for the PAD was observed to be 6.14 times more among the smokers as compared to nonsmokers. **Conclusion:** Cigarette smoking is a widespread addiction in India which is associated with PAD. By this study, we can send a message to quit smoking and prevent cardiovascular consequences of smoking.

KEY WORDS: Cigarette Smoking; Atherosclerosis; Peripheral Arterial Disease; Ankle Brachial Pressure Index

INTRODUCTION

"Every time you light up a cigarette you are saying that your life is not worth living."

The statutory warning "Smoking is injurious to health" signifies the hazards of smoking and yet the prevalence of smoking has increased many folds in the past few decades. The efforts and policies by the government to prohibit smoking by means of advertisement on television, radio, hoardings, movies, etc., did not lead to any fruitful results so far, as the smokers turn deaf ears to all the warnings. Smoking is associated with an increased risk of death and survival is reduced by 8 years in women and 6 years in men.[1] The tobacco epidemic is seen as one of the biggest public health threats with around 6 million deaths per year associated with smoking of which 5 million deaths are the result of direct tobacco exposure whereas more than 600,000 in nonsmokers who are exposed to second-hand smoke.[2] As per 2010 reports, by preventing smoking 1 million deaths or 10% of all deaths in India can be reduced because tobacco smoking is one of the largest preventable causes of death.[3]

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Most people are ignorant about the vascular consequences of tobacco smoking. Smoking is associated with atherosclerosis and smoking is the most significant risk factor for atherosclerosis. Atherosclerosis in lower limb leads to peripheral arterial disease (PAD) and can lead to intermittent claudication and limb dysfunction. Due to the paucity of screening methods, the prevalence of asymptomatic PAD patients is very high. However, ankle-brachial pressure index (ABPI) is an easy, consistent, precise, rapid, economical, non-invasive, and quantitative measurement which can be used as an initial test for screening and diagnosing PAD. It is used in clinical practice as the standard reference to establish the presence or absence of lower extremity atherosclerotic vascular disease.[4] The severity of atherosclerosis can also be predicted by ABPI and the risk of developing future leg problems such as leg rest pain, improper wounds healing, need for leg bypass surgery, or amputation.[5] Systolic blood pressure (BP) in the legs is normally equal to or slightly greater than the systolic pressure in the arms. BP in an artery distal to the occlusion is lower compared to the pre-occlusion part. The ABPI is calculated as the ratio of systolic BP of ankle to the brachial region. ABPI is a sensitive marker of peripheral arterial insufficiency. The highest pressure measured in any ankle artery is used as the numerator, and the highest pressure value of the brachial artery is taken as denominator during calculation of ABPI. A value >1.0 is considered to be normal and a value <0.90 is considered as diagnostic of PAD.[6]

Aim

The aim of the study was to compare the risk of PAD in male smokers and age-matched nonsmokers of Western Indian.

MATERIALS AND METHODS

Study Population

The Institutional Ethics Committee approval was obtained. Asymptomatic male tobacco smokers between the age of 20 and 40 years from Baroda Medical College and SSG Hospital, Baroda were selected as cases and healthy non-smoker males between 20 and 40 years of age were selected as controls. Staff members, resident doctors, patient relatives, and students of Baroda Medical College and SSG Hospital, Baroda formed the study population. A total of 121 cases (asymptomatic male smokers) and 121 controls (asymptomatic male non-smokers) were recruited for the study only after obtaining written informed consent. Individuals with continued h/o smoking for at least 1 year were considered as smokers. Adults who had never smoked tobacco till date were considered as nonsmokers. Both groups were age-matched (group matching for 10 years age group).

Subjects below 20 years and above 40 years of age were excluded from the study. Females were not included in the current study, considering the low prevalence of smoking, lack of reporting and reluctance to admit. Subjects with a history of (1) exposure to passive smoking, (2) hypertension or taking antihypertensive medication, (3) diabetes mellitus or taking antidiabetic drugs, (4) body mass index (BMI) >25.0, and (5) tobacco chewers, were also excluded from the study.

Instruments for Measuring ABPI

Handheld Doppler machine (Emco Meditek India, model no. D-580) 5–10 MHz, ultrasound gel, Stethoscope, and Sphygmomanometer were used.

Methods

Before starting the procedure, the test was explained and demonstrated to the subjects. BMI was calculated using height and weight recorded using Detecto Scales Inc. Brooklyn N.Y.U.S.A. Model No. 239. Subjects were then asked to lie down in the supine position. Following 5-min of rest baseline, systemic BP was recorded using sphygmomanometer. This was followed by measurement of ABPI using BP cuff and Doppler ultrasound in the supine position. A BP cuff was placed and inflated above the elbow. The Doppler probe was placed with ultrasound gel on the skin overlying the brachial artery. After the brachial artery has been occluded, the cuff was slowly deflated and the pressure at which the sound returns was considered as brachial systolic pressure. This procedure was performed 2 times in each arm, and the highest value was used in the ABPI calculation. Then, in a similar way, ankle systolic pressure was recorded using posterior tibial artery.[7]

The ABPI was calculated as: ABPI=ankle systolic pressure/brachial systolic pressure.

Statistical Analysis

Data were obtained mean ± standard deviation and were analyzed by independent student's *t* test. SPSS 16.0 was used. $P \leq 0.05$ was considered statistically significant.

RESULTS

The present case–control study included 121 smokers and 121 nonsmokers between the age group of 20 and 40 years. Their height, weight, and mean BMI were calculated and shown in Table 1.

The smokers were categorized into mild, moderate, and heavy smokers according to the smoking index.[8] Table 2 shows mean characteristics of age, height, weight, and BMI among the mild, moderate, and heavy smokers.

Measurement of BP in the right arm by sphygmomanometer in both the smokers and nonsmokers showed a significant difference only in systolic BP ($P = 0.001$) as shown in Table 3.

A significant difference was found in systolic BP between nonsmokers and mild, moderate, and heavy smokers. However, no significant difference was found in diastolic BP between nonsmokers and mild smokers, though the difference was significant between nonsmokers and moderate and heavy smokers ($P < 0.05$) as shown in Table 4.

On comparison of ABPI, a highly significant difference was observed between ABPI of smokers as compared to nonsmokers, on the right side as well as on the left side as shown in Table 5.

Table 1: Characteristics of the study population

Variables	Non-smokers Mean±SD (*n*=121)	Total smokers Mean±SD (*n*=121)
Mean age in years	28.69±4.68	30.34±4.69
Mean height in cm	167.97±8.77	169.46±7.49
Mean weight in kg	65.21±7.64	65.99±6.71
Mean BMI	23.07±1.49	22.96±1.52

BMI: Body mass index, SD: Standard deviation

Table 2: Age, weight, height, and BMI distribution in mild, moderate, and heavy smokers

Variables	Mild smokers Mean±SD (*n*=68)	Moderate smokers Mean±SD (*n*=42)	Heavy smokers Mean±SD (*n*=11)
Mean age (years)	28.52±3.95	31.19±3.78	38.46±2.87
Mean height in cm	168.93±7.88	169.40±7.00	173.00±6.30
Mean weight in kg	65.02±6.56	66.91±6.53	68.55±7.75
Mean BMI	22.77±1.50	23.30±1.59	22.82±1.23

BMI: Body mass index, SD: Standard deviation, Kg: Kilogram

Table 3: Comparison of mean systolic and diastolic blood pressure (in mmHg) among smokers and non-smokers

Variables	Systolic blood pressure Mean±SD	Diastolic blood pressure Mean±SD
Nonsmokers (*n*=121)	123.62±7.71	83.24±3.94
Total smokers (*n*=121)	127.74±6.90	83.70±3.82
P value	*P*<0.05	*P*>0.05

SD: Standard deviation, mmHg: Millimeter of mercury

When ABPI of mild smokers was compared with the nonsmokers, a highly significant $P < 0.005$ difference was observed on the right as well as on the left side. Similarly, ABPI of moderate and heavy smokers compared with the nonsmokers showed a highly significant difference ($P < 0.0001$) on the right as well as on the left side.

ABPI on the right side was compared with ABPI on the left side to find out any difference in ABPI between the right side and left side in both the groups, no significant difference was found between right side ABPI and left side ABPI in both the groups.

Low ABPI in smokers was suggestive of evolving PAD in smokers. Therefore, as seen in Table 6, the probability of PAD in smokers was found to be more among smokers as compared to nonsmokers with a relative risk ratio of 6.14. A study in 2004 to find out the association between smoking and peripheral vascular disease, found multi-fold increase in the risk of PAD in smokers and that smoking is a more influential risk factor for PAD than for coronary artery disease. Cessation of smoking reduces the risk of cardiovascular events and mortality. This may improve functional capacity in patients with PAD.[9]

DISCUSSION

In the present study, we compared the ABPI between male smokers and male nonsmokers. We noticed a highly significant difference between the ABPI of smokers compared to nonsmokers. We observed that smokers have 6 times more risk of developing the PAD. ABPI reflects the burden of atherosclerosis so it may be an independent predictor of mortality.[10] Only male smokers were included due to the low prevalence rate of female smokers in India and their reluctance to admit.[11]

As seen with systolic BP of nonsmokers and total smokers, there was a significant difference found in systolic BP between nonsmokers and mild, moderate, and heavy smokers. Systolic BP in smokers was higher than nonsmokers. Furthermore, there was a significant difference between diastolic BP of non-smokers and moderate and heavy smokers. Diastolic BP of smokers was higher than nonsmokers.[12] However, no significant difference was found in diastolic BP between nonsmokers and total smokers.[13]

Table 4: Comparison of mean systolic and diastolic blood pressure (in mmHg) among non-smokers and grades of smokers

Variables	Non-smokers	Mild smokers	*P* value	Moderate smokers	*P* value	Heavy smokers	*P* value
Systolic blood pressure Mean±SD	123.62±7.71	124.82±5.94	*P*<0.05	129.62±5.68	*P*<0.05	138.55±1.57	*P*<0.05
Diastolic blood pressure Mean±SD	83.24±3.94	82.38±3.65	*P*>0.05	84.76±3.39	*P*<0.05	87.82±1.89	*P*<0.05

SD: Standard deviation, mmHg: Millimeter of mercury

Table 5: Comparison of ABPI on the right and left side among smokers and non-smokers

Variables	Right ABPI Mean±SD	Left ABPI Mean±SD
Non-smokers	1.012±0.052	1.013±0.051
Total smokers	0.95±0.081	0.945±0.077
P value	<0.0001	<0.0001

ABPI: Ankle-brachial pressure index, SD: Standard deviation

Table 6: Prevalence of PAD among smokers and non-smokers

Variables	PAD	Not diseased	Relative risk in smokers
Smokers	43	78	6.14
Non-smokers	7	114	

PAD: Peripheral arterial disease

Results of this study showed that ABPI of mild smokers, moderate, and heavy smokers was significantly lower than nonsmokers. This difference was present on both the left and right sides of the body. Low ABPI in smokers is suggestive of evolving PAD. As seen in Table 6, the probability of developing a PAD in smokers is almost 6 times more than nonsmokers. Development of PAD can be confounded by many physiological and pathological risk factors. Studies have shown mixed results in this regard. Like old age and gender may[14] or may not[15] be a confounder. BMI,[16,17] hypertension,[18] and DM are shown to be significantly associated with the presence of PAD. Therefore, in the present study, we recruited apparently healthy young adults. Effect of duration/chronicity of smoking also seems to affect ABPI. Lowest ABPI was seen in heavy smokers than in moderate and mild smokers. A study also demonstrated similar results.[19] Another study to find out the prevalence of risk factors in patients with the PAD also found a positive correlation between smoking and PAD.[20]

Among the smokers, it was observed that the prevalence of PAD was significantly higher in heavy smokers as compared to mild and moderate smokers. A similar result was obtained in a study[21] which also concluded that cigarette smoking is a stronger risk factor for PAD than for coronary artery disease. Another study[22] based on analyses of 17 different studies, focused to find out the influence of smoking on incidence and prevalence of PAD found that the prevalence of symptomatic PAD was 2–3 times higher in current smokers. Even in former smokers, the prevalence of PAD increased by a factor of 2.6. It demonstrated a clear dose-response relationship in risk for developing PAD in heavy smokers. As patients of diabetes mellitus are also prone to have PAD,[23] we excluded subjects with history of diabetes mellitus.

Our study had some limitations. Cigarette smoking has multiple hazardous effects on the body. In our study, we focused only on PAD s of the lower limb, but smoking also causes coronary arterial disease,[24] early abdominal aortic atherosclerosis, aortic aneurysm, and other vascular defects which could not be evaluated by our study. Although we had excluded subjects taking antilipidemic drugs, we could not perform tests to exclude subjects with high cholesterol level.

CONCLUSION

PAD is almost 6 times more prevalent in smokers as compared to nonsmokers. Significantly, low ABPI is a reliable simple, non-invasive, reproducible, and cost-effective test to diagnose PAD patients. This can also be used to screen asymptomatic patients and thereby help in reducing morbidity and mortality among such patients.

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