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Physiology

COMPARISON OF GLYCOSYLATED HAEMOGLOBIN (HbA1c) LEVEL AMONG NON DIABETIC SMOKERS AND NON SMOKERS

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ABSTRACT

Introduction:- Cigarette smoking is associated with an increased risk of Type 2 diabetes mellitus. Glycosylated hemoglobin (HbA1c) is a marker of long-term glucose homeostasis reflecting an average blood glucose concentration in past 2-3 months. The effect of cigarette smoking on average blood glucose levels as measured by glycosylated hemoglobin have yet received little attention.

Aim and Objective: This study was done to assess the effect of smoking on blood glucose concentration by comparing glycosylated hemoglobin (HbA1c) between non-diabetic cigarette smokers and non-smokers.

Materials and Methods: This is a cross sectional case control study involving 60 participants with case group consists of 30, non-diabetic males of age group between 20-45 years. 30 healthy age matched non-obese males who do not smoke cigarette were recruited for control group. After an overnight fast of 12 hours the serum glucose concentration and the glycosylated hemoglobin levels were estimated in all subjects and the values were compared between the cases and control using students 't' test.

Results: There is no significant increase in the fasting serum glucose levels between the cases 89.72±9.92 and the controls 79.73±9.39. There is a significant increase in the glycosylated hemoglobin level in smokers 7.34±1.13 when compared with the non-smokers 5.69±0.44 with p-value < 0.001.

Conclusion: The results from the present study suggest that the level of glycosylated hemoglobin is increased in the non-diabetic smokers when compared to the non-smokers.

KEYWORDS : HbA1c, Smoking, Haemoglobin, Non- Diabetic

INTRODUCTION

Cigarette smoking is known to cause an elevation of blood glucose concentration. [1] The typical features of the insulin resistance syndrome are seen in chronic smokers and the extent of the related metabolic abnormalities are also associated with smoking habits. [2] Nicotine, which is one of the most abundant volatile alkaloid in cigarette, has been observed to increase plasma levels of catecholamines. [3] The increase in norepinephrine and epinephrine is followed by an increase in blood pressure and heart rate as well as other changes which can be attributed to increased adrenergic activity following cigarette smoking. Increases in plasma catecholamine level have been known to cause increase in hepatic glycolysis and gluconeogenesis and decrease in pancreatic insulin secretion in humans, [4] leading to increase in plasma glucose. Many previous studies had suggested that the cigarette smoking might be associated with the increased risk of type 2 diabetes mellitus in both males and females.

Glycosylated hemoglobin (Hb A1c) is a marker of long-term glucose homeostasis reflecting the average blood glucose concentrations in past 2-3 months. It is formed by non-enzymatic condensations of glucose with N-terminal valine residue of each β chain of Hb A. Microvasuclar complications of diabetes have been associated with the increase in the concentration of glycosylated hemoglobin(Hb A1c).

Protein glycation is a common form of protein damage and in normoglycaemic person approximately 1%-16% of albumin is glycated, which has been associated with metabolic deterioration. Advanced Glycation Endproducts (AGEs) are involved in the aetiology of diabetes and its complications .Glycated haemoglobin (HbA1c) is an early glycation product used diagnostically as a specific marker for glucose exposure.

HbA1c relates strongly to tissue damage in diabetic patients and it has been found to predict coronary heart disease and cancer in non-diabetic individuals, even within the 'normal' non-diabetic range (4.9 –6.3%) [23]. The study want to estimate the glycosylated hemoglobin (Hb A1c) levels in the non-diabetic cigarette smokers and the non-smokers and to compare the levels between the two groups to assess the effect of smoking on the glycosylated hemoglobin (Hb A1c)

MATERIALS AND METHODS:

This was a cross sectional case control study involving 60 participants. All the participants were selected randomly from the general population. Study population: The study group comprised of 30 non-diabetic males of age group between 20-45 years with smoking habits. 30 healthy age and BMI matched males who do not smoke cigarette were recruited in the control group.

Exclusion Criteria: Patients suffering from diabetes mellitus, hyper tension, anemia, renal disease, hepatic disease, hemogl obinopathies, acute or chronic blood loss and ischemic heart disease were excluded from this study.

Anthropometric measurements: The height and weight of the subjects were measured the Body Mass Index (BMI) was calculated by using Quetelet Index using the formula Wt(kg)/Ht(mt2).

Biochemical analysis: After twelve hours of overnight fast, 3ml of blood samples were obtained from all the subjects by venipuncture from cubital fossa in sterile vaccum tubes. Estimation of fasting glucose was done by standard glucose oxidase, GOD/POD method. Glycosylated hemoglobin was measured by High performance liquid chromatography (HPLC) method using D-10 HbA1c kit (Bio-Rad laboratories, USA)

Statistical analysis: The data from the cases and control groups were compared by using Student's t-test using SPSS (Statistical Package for Social Science) software, version 3.5. P values < 0.001 were considered to indicate statistical significance.

RESULTS: The average age of smokers and non-smokers was comparable and 30.16 ± 5.4 and 29.58 ± 6.2. In smokers FBS is (89.72gm/dl S.D. 9.92gm/dl) as compared to (79.73gm/dl S.D. 9.39gm/dl) in the non-smoking group .The normal range of HbA1c lies between (4.5-6.3%).The 30 smoking subjects had glycosylated hemoglobin levels ranging from 5.90% to 10.8% with an average of 7.34% (SD = 1.13%). The 30 non-smoking subjects had glycosylated hemoglobin levels ranging from 4.90% to 6.6% with an average of 5.69% (SD = 0.44%). These averages are significantly different .These results indicate that the smokers have glycosylated hemoglobin that is

25% higher than that of the non-smokers. (Fig 2)

Table 1:- Comparison of Age, Hb HbA1c, FBS among smokers and non-smokers.

Sl. No.	Parameters	Smoker	Non-Smoker	p-value
1.	Age	30.16 ± 5.4	29.58 ± 6.2	-
2.	FBS	89.72±9.92	79.73±9.39	> 0.001
3.	Hb	15.73± 0.70	13.53± 0.59	<.0001
4.	HbA1c	7.34±1.13	5.69±0.44	< 0.0001

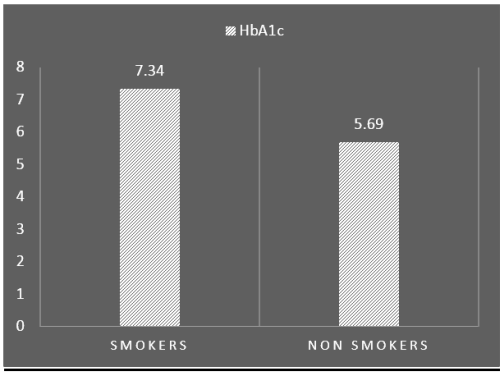

Fig: 2:- HbA1c level among smokers and non-smokers

There is increase in level of HbA1c with both duration and quantity of smoking as shown in figure 3

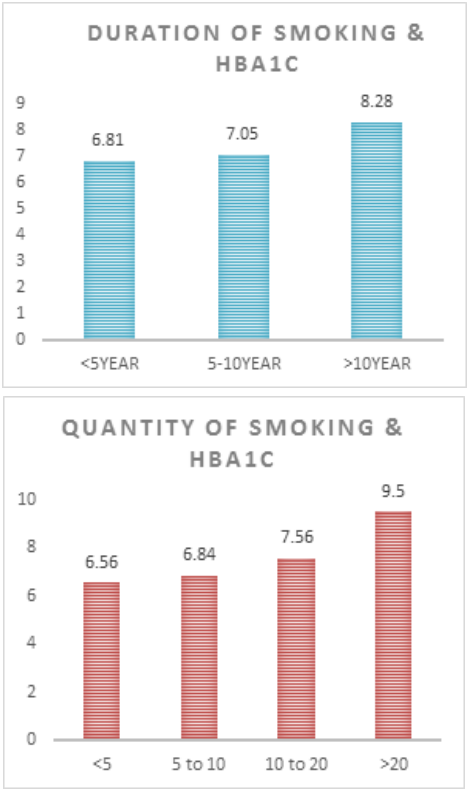

Fig: 3:- Variance of HbA1c with duration and Quantity of smoking

DISCUSSION:

In the present study the two groups of subjects were matched for age, Body Mass Index (BMI), Waist-to-hip ratio (WHR), physical activity and socio economic status. There is no significant difference in the fasting serum glucose levels was found between the smokers and non-smokers. As compared to non-smokers ,the cigarette smokers had significant increase in the glycosylated hemoglobin levels .Similar result is observed with the studies of Martin Urberg et al., 2011[5] and EPIC-Norfolk study by Lincolin et al., 20016 this can be attributed to be due to the nicotine, which has been demonstrated to increase plasma levels of catecholamines. [7] The increased norepinephrine and epinephrine in the plasma have been known to cause increased gluconeogenesis and hepatic glycolysis with decreased pancreatic insulin secretion in humans, leading to increased plasma glucose[3] These catecholamines might reduce the number of insulin binding sites as well as decrease the synthesis of glucose transporters leading to insulin resistance. Smoking also affects the mechanism involving insulin action (such as Signal transduction, glucose transport and/ or glucose phosphorylation) or by mechanisms operating simultaneously on different biochemical pathways. Further more, the antiestrogenic effect of nicotine could contribute to an increase in visceral adipose tissue accumulation and via this mechanism, insulin resistance. An alternative explanation for an apparent effect of cigarette smoking and glucose tolerance would be through increased oxidative stress. Increased oxidative stress may impair insulin action which is known to be increased in cigarette smoking [8]. Finally nicotine has influence on adiponectin a peptide that regulates food intake and body weight, all of which could contribute to higher HbA1C [9]

Further in the present study there is an increase in the level of mean glycosylated hemoglobin in smokers with increase in the duration and quantity of years of smoking. This association of smoking with HbA1c suggests long term effects that it may lead to increased risk of diabetes complications including cardiovascular disease.

CONCLUSION:

The results from the present study provide evidence of increased glycosylated hemoglobin (HbA1c) in non-diabetic smokers compared to the non-diabetic non-smokers. Smokers have been found to be at high risk for the development of diabetes mellitus. Our study has several limitations like the confounding factors like obesity, physical activity, dietary factors has not been investigated. Further study is needed to determine the clinical significance of this finding.

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