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RESEARCH ARTICLE

A STUDY ON ASSOCIATION OF CAROTID INTIMA MEDIA THICKNESS IN INDIVIDUALS WITH IMPAIRED FASTING GLUCOSE – A HOSPITAL BASED STUDY

Dr. Rintu Barman and Dr. Tridip Kumar Das

Assistant Professor, Department of Medicine, Assam Medical College and Hospital, Dibrugarh, Assam, Pin – 786001.

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Abstract

Introduction: Diabetes mellitus is one of the commonest endocrine disorder with multiple organ dysfunction as its complication. The early detection of atherosclerotic changes in the pre diabetic state would help us to take measures to prevent overt complication in later part of life.

Aim: To study the association of carotid intima media thickness in individuals with impaired fasting glucose.

Material and Method: A prospective study, a total of 30 patient and equally matched control were taken from patient attending at Medicine OPD for a period of one year. Routine lab investigation, lipid profile and B-mode Ultra sonography of the carotid intima media thickness of the selected cases as well as the control groups were done, thickening of the Intima-Media Complex greater than 0.8mm is considered abnormal, and represents the earliest changes of atherosclerotic disease.

Result: 18 individuals from cases and 5 individuals from control have significant increase in thickness of the common carotid intima-media thickness i.e. ≥ 0.8 mm.

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Introduction:-

Diabetes mellitus is the most common among endocrine and metabolic disorders. The effect of diabetes mellitus includes long-term damage, dysfunction and failure of various organs especially the eyes, kidney, nerves, heart, and blood vessels. The total number of cases in india is 19.4 million in 1995 and is expected to rise to 57.2 million in the year 2025.

The spectrum of glucose metabolism ranges from normal glucose to a pre diabetic state of impaired fasting glucose and impaired glucose tolerance followed by development of frank diabetes in most cases. The national urban diabetes survey in india has shown age standardized prevalence of diabetes and impaired glucose tolerance to be 12.4% and 14% respectively with no gender difference¹. In india, 77.2 million people had prediabetes in 2011².

The complication of diabetes mellitus is attributable to tissue damage due to vascular disease involving micro & macro vasculature. The most common pathology of micro-vessels occurs in retina, kidney & peripheral nervous tissue and of macro-vessels in peripheral arteries of lower limb, coronary vessels & in cerebral arteries. Macrovascular disease is the most important cause of mortality & morbidity in individuals with type 2 diabetes mellitus. Diabetes involves metabolic abnormalities including hyperglycemia, dyslipidemia & insulin resistance that disrupts normal arterial function & render arteries susceptible to atherosclerosis, which is an important risk factor of

Corresponding Author:- Dr. Tridip Kumar Das

Address:- Assistant Professor, Department of Medicine, Assam Medical College and Hospital, Dibrugarh, Assam, Pin – 786001.

coronary artery disease. Coronary artery disease in diabetic subjects is clearly associated with atheroma in other parts of arterial tree especially carotid artery intimal thickening. Although studies have shown type 2 diabetes mellitus is associated with atherosclerosis. Folson et al (stroke 25:66-73, 1994) have shown a direct evidence of atherosclerosis among prediabetic individual which was measured by the carotid wall intima media thickness³. Thus detection of an abnormality in the prediabetic state would present an opportunity for intervening to reduce the future burden of diabetes mellitus.

Measurement of carotid intima media thickness of carotid artery by ultrasonography is one of the non invasive qualitative method of evaluating early atherosclerotic changes .It is important to note that an increase in carotid intima media thickness is associated with an increased risk of cerebrovascular disease and coronary artery disease^{4,5}.

As studies have shown a wider variation among various ethnic group and geographical location besides others, a approach was made to study an association of carotid intima media thickness among individuals with impaired fasting glucose.

Materials and Methods:

Thirty cases of impaired fasting glucose were selected from patients attending in Assam Medical College and Hospital, Dibrugarh, Assam in the department of medicine within a period of one year were taken up for the present study.

Selection of cases:

1. Patients with age more than or equal to 45 years as per ADA criteria for screening were taken up for the study and screened for impaired fasting glucose. Thirty cases were selected randomly from the group.
2. The patients with the following conditions were excluded from the study:
A > Clinical features of D.M.
B > History of vascular disease.
3. The cases were examined thoroughly with detailed history and physical examination.
4. Equal number of age and sex matched subjects with standard height and weight were taken as control.
5. Routine lab investigation, lipid profile, was done.
6. B-mode ultra sonography of the carotid intima media thickness of the selected cases as well as the control groups were done :-thickening of the intima-media complex greater than 0.8mm is considered abnormal, and represents the earliest changes of atherosclerotic disease⁷.

Statistics:

Data evaluation was conducted using the spss/pc+ program. The level of significance was determined by $p < 0.05$. the correlation of glycemic parameters to int and to atherosclerosis risk factors was assessed using pearson or spearman correlation coefficient as appropriate.

Results and observation:-

After thorough history, clinical examination and laboratory investigations the subjects were categorized into two groups (group A for cases and group B for control).

The following results have been shown for the two groups:

1. Age distribution
2. Sex distribution
3. Blood pressure
4. Body mass index
5. Waist hip ratio
6. Fasting blood glucose
7. Serum cholesterol
8. Serum LDL and HDL-cholesterol
9. CCA-int

This data was analyzed by the student t test, and linear regression analysis and the results are shown with the necessary tabulation and graphic presentation.

Table 1:- Age distribution in the two Groups.

Age group in years	Group A		Group B	
	No	%	No.	%
45-<55	18	60	20	66.66
55-<65	10	33.33	6	20
>65	2	6.6	4	13.3
Total	30		30	

In the present study the age of the patients varied from ≥ 45 years to >65 years with maximum number of patients in the age group of 45-55 years. The mean ages of the patient were 54.46 ± 6.61 . Most of the patients in the control group were in the age range of 45-55 years (66.66%).

Table 2:- Showing the sex distribution.

Sex	Group A	Percentage (%)	Group B	Percentage (%)
Male	20	66.6	22	73.3
Female	10	33.3	8	26.6
Total	30		30	

Out of 30 cases, 20 were male and 10 female, the ratio between male and female being 2:1. Males and females were 22 and 8 respectively in the control group the ratio being 2.7:1.

Table 3:- Clinical data from subjects (group-A) and controls (group-B).

Characteristics	Group-A	Group-B	P-value
Systolic bp, mm hg	132.40 \pm 13.19	125.20 \pm 18.67	0.90
Diastolic bp, mm hg	73.93 \pm 9.22	69.67 \pm 10.86	0.107
BMI, kg/m ²	23.76 \pm 3.22	22.36 \pm 2.41	0.06
Waist hip ratio	0.89 \pm 0.12	0.85 \pm 0.71	0.09

As seen blood pressure was greater in group A than that of group B. The clinical presentation of both the group have been shown the mean systolic blood pressure in group A was 132 mm hg and that in group B was 125 mmhg. The mean diastolic blood pressure was found to be 73 and 69 respectively. However there was no significant difference as it is evident from the p-value. In group A the mean BMI was 23.76 kg/m² and in group B the mean BMI was 22.36 kg/m², which shows no statistical significance. The mean waist hip ratio in group A was 0.89 and that of group B was 0.85. Again this difference was not statistically significant.

Table 4:- Biochemical data from subjects (group A) and controls (group B).

Characteristics	Group A	Group B	P-value
FBG, mg/dl	114.8 \pm 5.86	88.90 \pm 9.74	<0.001
S.cholesterol, mg/dl	206.33 \pm 23.30	198 \pm 23.06	0.18
S.LDL-cholesterol, mg/dl	121.06 \pm 12.25	114.83 \pm 8.15	0.02
S.HDL-cholesterol, mg/dl	30.83 \pm 7.69	31.63 \pm 7.41	0.68
S.triglyceride, mg/dl	242 \pm 36.00	198.90 \pm 21.41	<0.001
CCA-imt, mm	0.9 \pm 0.18	0.70 \pm 0.09	<0.001

The above table shows the biochemical parameters in both the groups. The mean fasting blood glucose in group A was 114.8 mg/dl and that in group B was 88.90 mg/dl, which shows a statistically significant difference. The mean serum cholesterol in group A was 206.33 mg/dl and that in group B was 198 mg/dl. The mean LDL-cholesterol in group A was 121.06 mg/dl and that in group B was 114.83 mg/dl. The difference between the mean serum cholesterol were not significant while the mean serum LDL-cholesterol was found to be

statistically significant. The mean serum HDL-cholesterol in group A and group B was found to be 30.83 mg/dl and 31.63 mg/dl respectively. The mean serum triglyceride in group A was 242 mg/dl and in group B was 198.90 mg/dl, which was found to be statistical, significant. The mean common carotid intima media thickness in group A was found to be 0.9mm and that in group B was 0.70, which shows a statistically significant difference.

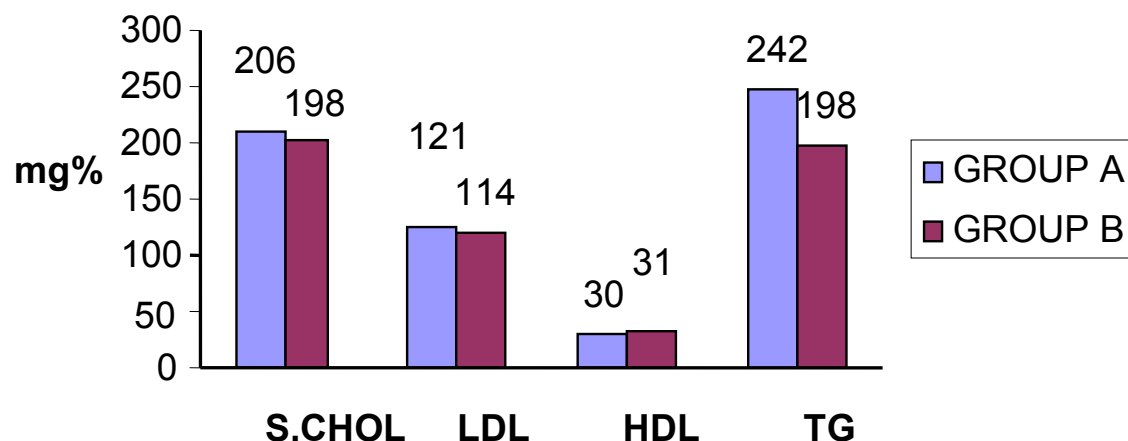


Figure1:-Comparison of mean Lipid Profile

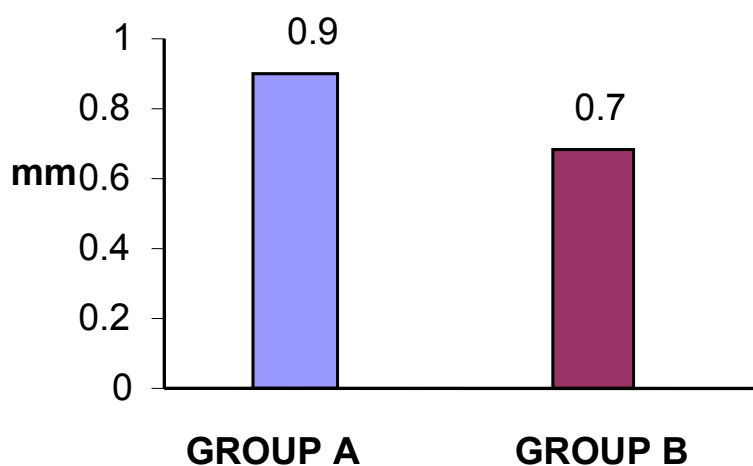


Figure 2:-Comparison of the mean CCA-imt

Table 5:-Common carotid intima-media thickness in subjects and controls.

Characteristic	Group A		Group B	
	No	%	No	%
$\geq 0.8\text{mm}$	18	60.0	5	16.6
$\leq 0.8\text{mm}$	12	40	25	83.3

It is seen from the above table that 18 individuals from group A and 5 individuals from group B have significant increase in thickness of the common carotid intima-media thickness i.e. $\geq 0.8\text{mm}$.

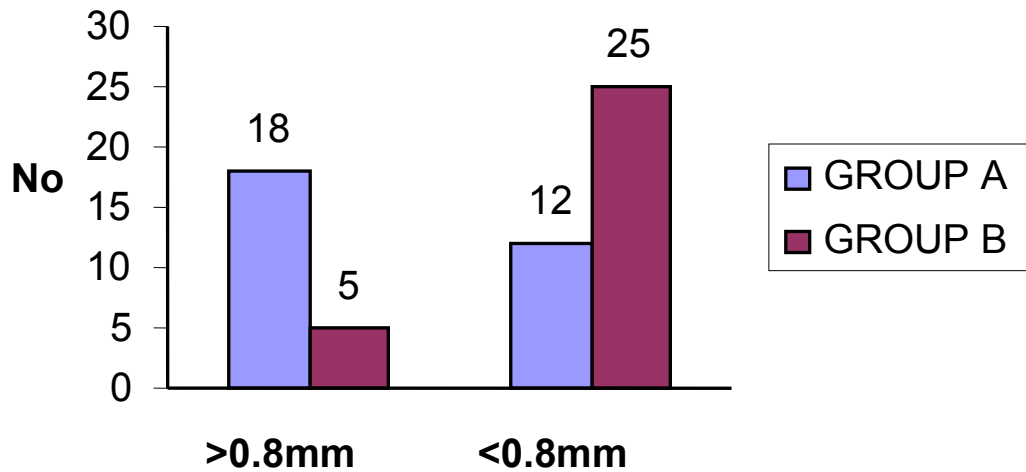


Figure 3:- Comparison of CCA-imt.

Table 6:- Correlation coefficients of parameters in subjects and controls.

Characteristics	Correlation coefficient	
	Group A	Group B
Age and imt	0.120	0.213
BMI and imt	0.3490*	0.307
Age and FBG	0.045	0.506
BMI and FBG	0.4330*	0.246
SBP and imt	0.4434*	0.039
DBP and imt	0.4808**	0.111
SBP and FBG	0.3778*	0.014
DBP and FBG	0.5526**	0.126
Tg and imt	0.3886*	0.179
LDL and imt	0.068	0.027
Tg and FBG	0.4930**	0.230
LDL and FBG	0.064	0.158
FBG and imt	0.5432**	0.146

*= (p=<0.5),

**=(p=<0.01)

It is seen from the above table, that there is positive statistical significant correlation between the body mass index, systolic blood pressure, diastolic blood pressure, triglyceride, and fasting blood glucose with common carotid intima media thickness in group A while in the control group, there is no significant correlation.

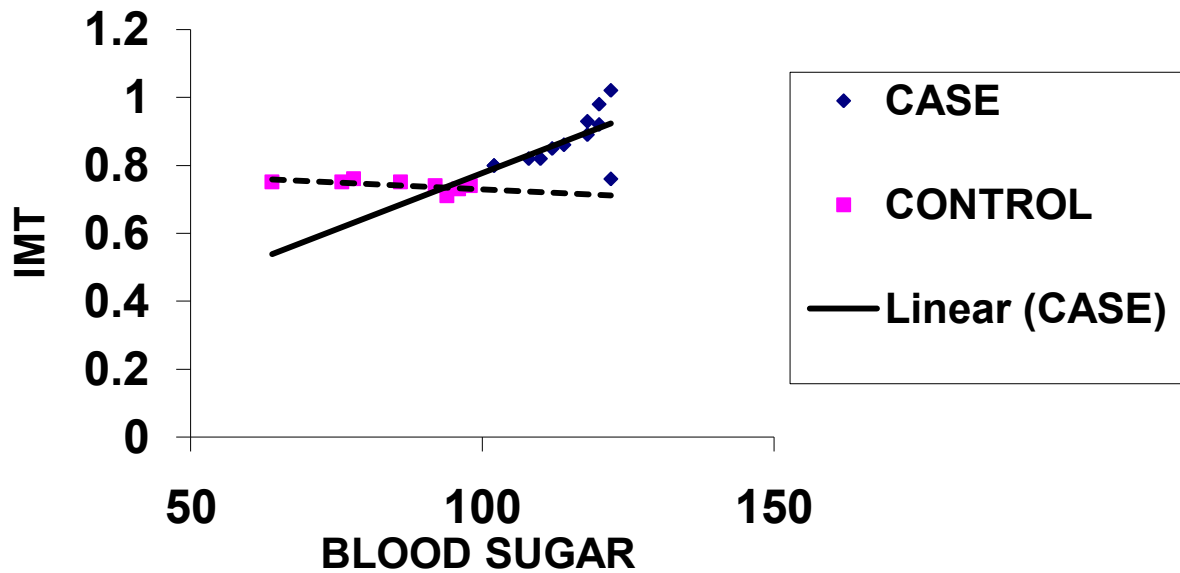


Figure 4:-Correlation of imt and blood sugar in Group A and Group B
 Group A (case) = a linear correlationship
 $Y = -1.054 + 0.017 \times \text{ifg}$
 $r^2 = 0.543224$ ($p < 0.001$)
 Group B (control) = a linear correlationship
 $Y = 0.835 + 0.001 \times \text{fbs}$
 $r^2 = 0.146$ ($p > 0.05$)

The above figure shows a linear statistical significant correlationship between the blood sugar and the intima media thickness in group A ($p < 0.001$), while in group B there is linear correlation ship which is not significant ($p > 0.05$).

Summary:

The present study was conducted in the department of medicine, Assam Medical College & Hospital, Dibrugarh for a period of one year. The aim and objectives of this study were to study the association of carotid intima media thickness in individuals with impaired fasting glucose.

By following the inclusion and exclusion criteria as mentioned under materials and methods, thirty cases of impaired fasting glucose selected randomly from patients with age more than or equal to 45 years attending at department of medicine. All of them were assessed clinically and then subjected to laboratory investigations. The various observations from the study are summarized as follows:

1. The sex ratio in the population was 2:1 (male: female).
2. Maximum number of cases was seen in the age group of 45—55 years followed by 55—65 years.
3. The mean systolic blood pressure was found to be 132.40 mm hg, while diastolic pressure to be 73.93 mm hg.
4. The mean BMI was 23.76 kg/m²
5. The mean waist hip ratio was 0.89.
6. The mean serum fasting blood glucose was 114.8 mg/dl.
7. Among the lipid profile, the total cholesterol, LDL, and HDL were 206.33, 121.06 and 30.83 mg/dl respectively. However there is significant increase in triglyceride level with mean of 242 mg/dl.
8. The mean carotid intima media thickness was found to 0.9 mm. Which is above the

normal value of 0.8mm. Out of the 30 cases, 18 had values above ≥ 0.8 mm.

9. On studying the correlation between the various parameters, the study shows a statistically significant ($p < 0.05$) correlation between BMI, blood pressure triglyceride and carotid intima media thickness. Also the study shows a highly significant correlation between the impaired fasting glucose and carotid intima media thickness.
10. In the control group, 5 individuals had carotid intima media thickness of ≥ 0.8 mm. Although there were correlation between the various variables i.e. BMI, blood pressure, triglyceride and carotid intima media thickness, but these correlation were not significant. Similarly there was no significant correlation between the fasting blood glucose and carotid intima media thickness in the control group.

Discussion:-

Diabetes mellitus is the most common of serious metabolic diseases of human being. In addition there is a large pool of subject with impaired glucose tolerance with a high risk of conversion to diabetes. The national urban diabetes survey in India has shown age standardized prevalence of diabetes and IGT to be 12.4% and 14% respectively with no gender difference¹.

The present study comprises of 30 cases of impaired fasting glucose selected randomly from patients with age more than 45 years attending into the medicine department of Assam Medical College & Hospital, Dibrugarh, during the period of one year.

The American association does not recommend screening the general population for diabetes, but instead uses a risk-based approach. Since age is a risk factor in becoming diabetes, ADA recommends screening should begin at age of 45 years. Here in the present study too 30 cases were selected randomly from patients of age more than 45 years. The present study has shown a mean of 54.46 ± 6.61 yrs with majority i.e. 60% within the age group of 45 to 55 years of age, followed by 33.33% present in the age group of 55-65 years. Temelkova (2000) reported the largest number of cases at ages 46—58 years (52%)⁷.

The overall male: female ratio in the present series is 2: 1. Yalin guan et al reported a male to female ratio of 1:1.4⁸. Various explanations have been suggested regarding the lower incidence of diabetes amongst females in India viz. Their reluctance to attend clinics, greater physical activity or their austerity in respect of dietary intake.

Similar to the observation that BMI > 25 was nearly seven times in diabetes than in non-diabetics. David rivera (2003) reported a mean BMI of 31.6 of the 66 prediabetic individuals selected for his study⁹. The present study shows a mean of 26.75 ± 2.65 kg/m² which were below the observation as recorded by the other study. Yalin guan et al has reported 67.1% of the prediabetics cases selected for study were hypertensive⁸. The present study has shown hypertensive to be present in 43.33% of the study population this can be explained, as most of the patients that attend at this hospital were from rural low income group and physical labourer.

Kellyj.hunt (2003) in his study of atherosclerosis in prediabetic's individuals has reported a mean total serum cholesterol to be 211mg/dl⁹. The present study shows the mean serum cholesterol to be 206.33mg/dl, which correlates with the aforementioned finding.

It is seen that 18 cases (i.e. 60%) had a significant increase in the carotid intima media thickness (> 0.8 mm). Kelly j hunt has reported a significant increase in carotid intima thickness in the prediabetic cases vs nondiabetic⁹, however there are other studies too which do not find a significant correlation of carotid intima media thickness in prediabetes.

The present study shows a statistical significant correlation between the impaired fasting glucose and the carotid intima media thickness ($p = <.001$). On univariate analysis, there is a statistical significant correlation ($p = <0.5$) between the various glycemic parameters i.e body mass index, blood pressure, triglyceride to carotid intima media thickness (table 6). The Mexico City Diabetes Study has reported a significant increase in carotid intima thickness among the prediabetic individuals and also reported the increase in coronary heart risk factors in individuals before the onset of clinical diabetes. Similarly Folsom et al (1994) has reported a positive relationship between fasting non-diabetic hyperglycemia and carotid intima media thickness³. Thus the present study is in accordance with the above mentioned studies.

Limitation of the study:

1. The number of cases was low, so the exact picture as depicted in other studies could not be found.
2. As this is a hospital based study, most of the patients were from lower socioeconomic or middle class family, the study population cannot be general.
3. In the present study univariate analysis was done, further study is necessary to find out the multivariate analysis.
4. As the present study is not a prospective cohort study, a long term follow up of the patients was not possible to see the utility of IMT in predicting coronary artery disease.

Conclusion:-

The present study clearly demonstrates that the carotid intima media thickness is significantly increased in Indian subjects in this part of the country with impaired fasting glucose and that besides impaired fasting glucose, BMI, systolic blood pressure, diastolic blood pressure, triglyceride emerged as a significant independent determinant with linear relationship with impaired fasting glucose. Also the present study is an example of evidence based medicine, in correlating the relationship between impaired fasting glucose and carotid intima media thickness. However further study is necessary with large number of cases to see the utility of this association. Given the already established relationship between the involvement of coronary artery and the carotid artery, early detection of the increased carotid intima media thickness in risk individuals will prevent the development of coronary artery disease in long run.

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