THE STUDY OF CAROTID INTIMA MEDIA THICKNESS IN PREDIABETES AND ITS CORRELATION WITH CARDIOVASCULAR RISK FACTORS

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ABSTRACT

BACKGROUND

Metabolic syndrome, insulin resistance, prediabetes and Diabetes Mellitus (DM) type 2 are all associated to a more extensive and even premature atherosclerosis both in the coronary and the carotid arteries. They are all found to be associated with cardiovascular risk factors. Carotid Intima Media Thickness (CIMT) is considered surrogate marker of atherosclerosis, early and cheap method of detection of Cardiovascular Disease (CVD). It is necessary to assess CIMT in prediabetes for cardiovascular morbidity and mortality.

MATERIALS AND METHODS

This was a prospective case control study of carotid intima media thickness in prediabetes. A total of 100 patients of prediabetes and equal number of age and sex matched controls were enrolled. After detailed history and clinical examination, bilateral assessment of intima media thickness was done in common carotid artery. Statistical analysis was done by using descriptive and inferential statistics.

RESULTS

Mean value of CIMT for cases (0.79±0.06 mm) was higher than for controls (0.72±0.02 mm). The difference in the two groups was found to be statistically significant (P<0.05, S).

CONCLUSION

Mean CIMT was higher in prediabetes group in comparison to controls, however, was not in abnormal range. According to this model on multiple regression analysis among cases, serum Triglyceride (TG) and age were found to be responsible for increased CIMT.

KEYWORDS

Carotid Intima Media Thickness, Cardiovascular Disease.

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BACKGROUND

With an increasing incidence worldwide, DM will be a leading cause of morbidity and mortality in the foreseeable future. Diabetes in its early stage is categorised as prediabetes.[1] An individual is considered to be prediabetic, if he/she has a blood glucose level that is above normal, but below the diagnostic threshold for diabetes mellitus. Prevalence of prediabetes is also increasing worldwide, 79 million people had prediabetes in United Sates as per American Diabetic Association - January 26, 2011.[2] In India, 77.2 million people had prediabetes in 2011.[3]

Studies implicate glucose per se for the increased cardiovascular risk, an abnormality of glucose regulation rarely occurs in isolation. Moreover, it tends to cluster with other known cardiovascular risk factors. This clustering of impaired fasting glucose with hypertension, visceral obesity, and atherogenic dyslipidaemia (low HDL cholesterol or high triglycerides) is known as metabolic syndrome. The presence of metabolic syndrome increases the risk of atherosclerotic cardiovascular disease.[4,5]

Carotid Intima Media Thickness (CIMT) is an indicator for early carotid atherosclerosis. Various studies have previously shown that an increased CIMT is associated with the established risk factors for cardiovascular disease, coronary atherosclerosis and cardiovascular morbidity.[6]

Prevention of cardiovascular disease in prediabetes prior to onset of diabetes is likely to be the most fruitful method

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of mitigating some of the well-known adverse consequences of diabetes. Keeping this in view, the study of CIMT and other cardiovascular risk factors in prediabetes was undertaken.

Aims and Objectives

1. To study carotid intima media thickness in prediabetes.
2. To correlate carotid intima media thickness with cardiovascular risk factors.

MATERIALS AND METHODS

This study was conducted in the Department of Medicine, Jawaharlal Nehru Medical College, AVBR Hospital, Sawangi (Meghe), Wardha. This was a cross-sectional case-control study conducted from September 2014 to September 2016. The study protocol was approved by the Ethical Review Committee and written informed consent was obtained from the study participants.

Cases- Prediabetes, fulfilling following criteria. Fasting blood glucose level is between 110 mg/dL and 125 mg/dL or two-hour plasma glucose level after 75 g OGTT is between140 to 199 mg/dL- (WHO 1999).[7]

Controls -Age and sex matched.

Not consenting patients, type I/ type II DM, smokers and alcoholics were excluded.

Methods- Detailed history, demographic and clinical examination of all cases and controls was done. Anthropometric features including weight, height, BMI (body mass index), Waist Circumference (WC) and Hip Circumference (HC) were measured by standard methods.[8,9] Biochemical tests including Fasting Blood Sugar (FBS), 2-hour OGTT, serum Total Cholesterol (TC), Triglyceride (TG), High-Density Lipoprotein (HDL), Low-Density Lipoprotein (LDL) and Very Low Density Lipoprotein (VLDL) were done.

CIMT (Carotid Intima Media Thickness) was measured by Aloka Prosound with linear probe of 5-7 Hz in B-mode.

Intimal medial thickness is defined as the distance between the leading edge of the first echogenic line (lumen-intimal interface) and the second echogenic line (media-adventitia interface) of the far wall.[10] Three measurements were taken at 0.5, 1 and 2 cm below the carotid bifurcation of the Common Carotid Artery (CCA) on each side and their average was calculated. For better reproducibility of IMT, measurement values from right and left CCA were combined. The latest ESH/ESC hypertension guidelines (2013) carotid IMT >0.9 mm was considered abnormal, which has been confirmed as a marker of asymptomatic organ damage.[10]

Statistical Analysis- was done by using descriptive statistics and inferential statistics using Chi-square test, Odd's ratio, Pearson's correlation coefficient and multiple regression analysis. The software used in this analysis was SPSS version 17.0 and Graph Pad Prism version 5.0. A 'p' value <0.05 is considered was a level of significance.

OBSERVATIONS

Characteristics	Cases (n=100)	Control (n=100)
Age in years	45.06±13.08	44.15±13.64
Male	56	58
Female	44	42
BMI (kg/m^2)	23.01±1.65	21.33±1.92
Waist-hip ratio - Male	0.88±0.06	0.81±0.06
Waist-hip ratio - Female	0.85±0.04	0.79±0.06
Waist circumference (cm)	88.89±6.55	81.65±6.83
F/H/O DM	43%	36%
SBP (mmHg)	132.20±18.08	121.32±15.37
DBP (mmHg)	85.44±10.69	79.12±9.04
FBS (mg/dL)	117.38±4.16	100.21±3.68
Left CIMT (mm)	0.79±0.05	0.73±0.02
Right CIMT (mm)	0.79±0.06	0.72±0.02
Sr. Cholesterol	197.62±23.85	176.81±21.64
Sr. HDL (male)	40.33±5.11	45.43±5.27
Sr. HDL (female)	42.06±6.21	46.88±4.89
Sr. LDL (mg/dL)	101.42±15.84	92.29±14.90
Sr. VLDL (mg/dL)	40.63±5.80	34.37±2.89
Sr. TG (mg/dL)	158.62±28.45	139.17±13.18

Table 1. Baseline Characteristics of Study Population

In our study, dyslipidaemia, hypertension and CIMT was found to be higher in prediabetes group in comparison to controls (Table 1).

CIMT (mm)	Cases (n=100)	Controls (n=100)	z-value	p-value
Left CIMT	0.79±0.05	0.73±0.02	9.82	0.0001, S
Right CIMT	0.79±0.06	0.72±0.02	9.36	0.0001, S
Mean CIMT	0.79±0.06	0.72±0.02	9.67	0.0001, S

Table 2. Comparison of Carotid Intima Media Thickness (CIMT) Values in Cases and Control

Mean CIMT for cases was 0.79 mm with a standard deviation of 0.06 and mean CIMT for controls was 0.72 mm with a standard deviation of 0.02.

Mean CIMT was higher in cases than controls, which was statistically significant (p <0.05, S) (Table 2).

	Unstandardised Coefficients		Standardised Coefficients	t	p-value
	B	Std. Error	Beta		
CIMT	0.205	0.272			
Age	0.001	0.001	0.301	2.251	0.027, S
Gender	0.003	0.014	0.022	0.196	0.845, NS
BMI	0.002	0.004	0.047	0.477	0.634, NS
Waist circumference	0.001	0.004	0.064	0.161	0.872, NS

WHR	0.182	0.388	0.181	0.469	0.641, NS
F/H/O DM	0.012	0.013	0.098	0.930	0.355, NS
SBP	0.000	0.001	-0.146	0.627	0.533,NS
DBP	0.002	0.001	0.333	1.514	0.134, NS
PMBS	0.000	0.001	-0.085	0.828	0.410, NS
FBS	0.001	0.001	0.097	0.975	0.332, NS
TC	0.000	0.000	0.041	0.365	0.716, NS
HDL	0.000	0.001	-0.069	0.654	0.515, NS
VLDL	0.001	0.001	0.060	0.536	0.594, NS
LDL	0.000	0.000	-0.176	1.394	0.167, NS
TG	0.001	0.000	0.278	2.122	0.037, S

Table 3. Multiple Regression Analysis in Cases

Multiple regression analysis in cases showed that only serum triglycerides and age were significantly associated with increased CIMT ($p<0.05$, S) (Table 3).

DISCUSSION

Mean CIMT in prediabetes group was 0.79±0.06 and controls was 0.72±0.02 ($p<0.05$, S). Similarly, David Faeh et al observed correlation between cardiovascular risk factors, carotid/femoral intima media thickness in prediabetes group. Mean CIMT (mm) was 0.76 ± 0.02 in prediabetics (IFG/IGT) and 0.71 ± 0.01 in controls (NFG), which was statistically significant ($p<0.001$, S). Also, Hulya Parildar et al studied carotid intima media thickness in prediabetics. They found left, right and maximum CIMT were statistically higher among prediabetics. In prediabetes group (n=110), mean left CIMT was 0.78 ± 0.23 mm, right CIMT was 0.73 ± 0.18 mm and maximum CIMT 0.75 ± 0.19 mm. In control group (n=76), mean left CIMT was 0.62 ± 0.16 mm, right CIMT was 0.63±0.14 mm and maximum CIMT was 0.62 ± 0.14 mm, which was statistically significant ($p<0.001$, S).[11]

On multiple regression analysis in cases, serum triglyceride and age were found to be significantly associated with increased CIMT. Similarly, Hulya Parildar et al studied carotid artery intima media thickness in prediabetics. That model showed age and BMI were found to be responsible for 40% of the variability in maximum CIMT.[11] Also, Associate Professor, Iana Simova in an article from the e-journal of the ESC Council for Cardiology Practice stated that first structural change that can be detected in atherosclerosis is an increase in IMT due to increasing age.[10]

CONCLUSION

1. Total cholesterol, Low-Density Lipoprotein (LDL), Triglyceride (TG), very low density lipoprotein were significantly higher in prediabetes and High-Density Lipoprotein (HDL) was significantly lower in prediabetes as compared to controls.
2. CIMT was higher in prediabetes in comparison to controls, however, in both groups, CIMT was not in abnormal range.
3. According to this model, among cases serum Triglyceride (TG) and age were found to be responsible for increased CIMT.

RECOMMENDATIONS

Prediabetes run higher risk (50% chance) of developing overt diabetes over the next 10 years as well as have increased cardiovascular risk factors and increased CIMT as surrogate marker for atherosclerosis for developing cardiovascular disease. Moreover, lack of guidance makes prediabetes unnoticed and undiagnosed. So, we recommend proper screening for prediabetes and associated risk factors and introduce a healthy lifestyle or pharmacotherapy for those prediabetics to decrease the risk of cardiovascular disease.

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