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Research Article

Myocardial Performance Index In Prediabetes In Medical Staff

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Abstract:

Background: To study myocardial performance index in prediabetes in medical staff. To correlate MPI with cardiovascular risk factors.

Methods: After subject selection, informed consent was taken from the cases and controls. Detailed history was taken and physical examination was done which included weight, height, body mass index (BMI), waist circumference, hip circumference, waist-hip ratio (WHR) and blood pressure measurement. After physical examination, biochemistry measurements including fasting blood sugar (FBS), post-meal blood sugar (PMBS), serum total cholesterol (TC), triglyceride (TG), high-density lipoprotein (HDL), low-density lipoprotein (LDL) and very low-density lipoprotein (VLDL) were done. Myocardial performance index (MPI) was calculated by 2D-ECHO.

Results: BMI, male WHR, serum cholesterol, TG, LDL and MPI was significantly higher in cases (prediabetics) as compared to controls while serum HDL was lower in cases as compared to controls, which was non-significant. Out of 50 prediabetics, 32 (64%) had abnormal MPI with p=0.0001. There was no correlation of MPI with cardiovascular risk factors like BMI, WHR and fasting lipid profile.

Conclusion: BMI, male WHR, serum cholesterol, TG, LDL and MPI was significantly higher in cases as compared to controls. However, there was no significant correlation between MPI and other cardiovascular risk factors.

Keywords: myocardial performance index, LV dysfunction, prediabetes, cardiovascular risk factors

Introduction:

According to the International Diabetes Federation (IDF), as of 2015, about 415 million people were suffering from diabetes mellitus (DM) worldwide. This is estimated to increase to a remarkable 642 million people by the year 2040. India is one of the 6 countries of the IDF South East Asia - (SEA) region. Out of the 415 million people worldwide, about 78 million people are in the SEA region; by 2040 this will rise - to 140 million. Mortality is about 5 million people in 2015. [(1)]

In India, 41 million people are Type 2 DM and by 2025, the number is expected to be 68 million. India is called diabetic capital of the world. [(2)]

The weighted prevalence of DM (both known and newly diagnosed) was 13.6 in Chandigarh, 10.4 in Tamil Nadu, 8.4 in Maharashtra, and 5.3 in Jharkhand. [(3)] The prevalence of prediabetes (impaired fasting glucose and/or impaired glucose tolerance) was 14.6 in Chandigarh, 8.3 in Tamil Nadu, 12.8 in Maharashtra, and 8.1 in Jharkhand. [(3)]

According to the phase I results of the Indian Council of Medical Research study carried out from 2008 to 2011, there are 62.4 million people and 77.2 million people suffering from DM and prediabetes, respectively. [(3)]

Multiple logistic regression analysis showed that age, sex (males), family history of diabetes, urban residency, abdominal obesity, generalized obesity, hypertension and income status were significantly associated with DM. [(3)]

Significant risk factors for prediabetes were age, family history of DM, abdominal obesity, hypertension and income status. [(3)]

WHO Criteria for diagnosis of prediabetes, as stated by Buysschaert & Bergman in 2009 are:

Fasting blood glucose level is between 110 mg/dL and 125 mg/dL (IFG) or

Two-hour plasma glucose level after 75-g OGTT is between 140 to 199 mg/dL. [(4)]

The relative risk for development of type 2 DM was 7.6% in prediabetics and 0.6% in normoglycemics. [(5)]

DM is metabolic disorder leading to microvascular complications like nephropathy, neuropathy, retinopathy and macrovascular complications like cerebrovascular, cardiovascular and peripheral vascular diseases.

Pre-diabetes is not only a significant risk factor for progression to type-2 diabetes but is also considered a risk factor for macrovascular disease and for retinopathy. Some of this risk may be associated with progression to overt diabetes, but there is still increased risk in individuals who have not yet progressed to diabetes.

A meta-analysis of 38 prospective studies suggests that post glucose challenge blood glucose levels in the nondiabetic range appear to have a linear relationship with cardiovascular disease risk and a possible threshold risk with fasting plasma glucose of about 100 mg/dL (5.6 mmol/L). [(6)]

Although DM is known to be related with left ventricular dysfunction even after hypertension and coronary artery disease are excluded, the association between prediabetes and left ventricular function has not been comprehensively investigated in general population, and specifically in medical staff.[7] Therefore, we intend to investigate left ventricular functions by myocardial performance index in prediabetes in medical staff.

Aim:

To study myocardial performance index in prediabetes in medical staff.

Objectives:

To correlate MPI with cardiovascular risk factors.

Material and Methods:

Study type: Case-control observational study.
Site of study: This study was carried out in the Department of Medicine, Jawaharlal Nehru Medical College (JNMC), Acharya Vinoba Bhave Rural Hospital (AVBRH), Sawangi (Meghe), Wardha, Maharashtra.
Duration of study: The study was carried out for 2 months, from June 2017 to July 2017.
Sample size: 50 cases and 50 controls.
Cases: Staff above 18 years working at AVBRH who fulfill the WHO criteria for prediabetes: fasting blood glucose level is between 110 mg/dL and 125 mg/dL (IFG), or two-hour plasma glucose level after 75-g OGTT is between 140 to 199 mg/dL (IGT).[4]
Controls: Asymptomatic individuals with age and sex matched.
Exclusion criteria: Hypertensives, chronic smokers, chronic alcoholics, diagnosed diabetes mellitus, individuals suffering from ischemic heart disease, any congenital heart disease, or any chronic systemic disease.
Ethics Committee approval: Institutional Ethics Committee clearance was obtained.
Methods: Informed consent was taken from the cases and controls. Each case and control detailed history taking and physical examination was done:

a. Anthropometric Assessment

Anthropometric features including weight, height, body mass index (BMI), waist circumference (WC), hip circumference (HC) and waist-hip ratio were measured by standard method.

b. Blood Pressure Measurement

Blood pressures (BP) in both arms were measured with a standard mercury sphygmomanometer in supine position with a standard size cuff after one-minute rest. Mean values were determined from two independent measurements taken at 5-minute's interval.

c. Biochemistry Measurements

Biochemistry measurements including fasting blood sugar (FBS), post-meal blood sugar (PMBS), serum total cholesterol (TC), triglyceride (TG), high-density lipoprotein (HDL), low-density lipoprotein (LDL) and very low-density lipoprotein (VLDL) were done.

d. Myocardial Performance Index

Myocardial performance index (MPI) was calculated by 2D-ECHO. All echocardiographic examinations were carried out using 2.5-3.5 MHz transducer with the Vingmed System 7 (Vivid 7, GE, Horten, Norway). Two-dimensional, M-mode and subsequent tissue Doppler echocardiography (TDE) and quantitative analysis was conducted on parasternal long axis, short axis and apical four-chamber images according to the data provided by the American Society of Echocardiography.[8]

Left ventricular systolic and diastolic functions were analyzed using standard two-dimensional (2D) echocardiography, M-mode echocardiography, pulsed wave (PW) echocardiography and TDE. TDE was used to obtain LV myocardial velocities in the apical four-chamber view with a 5 mm sample volume on the medial and lateral corner of the mitral annulus and the mean results of these parameters were obtained. TDE program was set to the PW Doppler mode. Filters were set to minimize high-frequency signals, and Nyquist limit was adjusted to a velocity range of - 15 to 20 cm/s. The following measurements were obtained in each region as: myocardial isovolumetric relaxation time ($IVRT_m$), myocardial isovolumetric contraction time ($IVCT_m$), myocardial ejection time (ET_m). MPI was calculated by summing $IVCT_m$ and $IVRT_m$ and dividing by ET_m value.

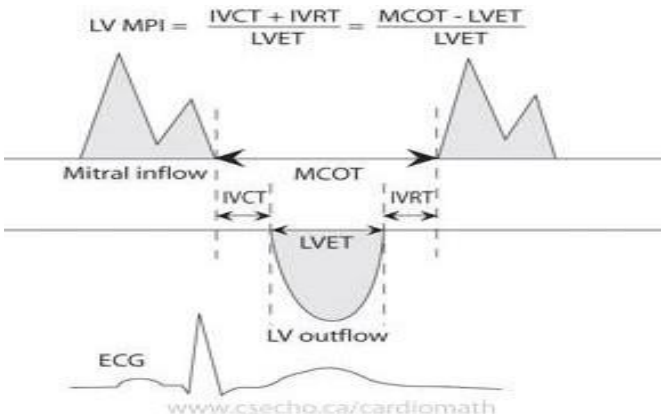

Fig. 1. Measurement of Doppler intervals. Myocardial performance index (MPI) is defined as the sum of isovolumic contraction time ($IVCT_m$) and isovolumic relaxation time ($IVRT_m$) divided by ejection time (ET_m). The sum of $IVCT_m$ and $IVRT_m$ is equal to the difference between the interval from cessation to onset of the mitral inflow (MCO) and ET.

Statistical Analysis:

In this case-control observational study, statistical analysis was done by using descriptive and inferential statistics using Chi-square test and Pearson's correlation coefficient. Software used in the analysis were SPSS 20.0 version and GraphPad Prism 6.0 version and $p < 0.05$ is considered as level of significance.

Observations and Results:

This study was conducted in AVBRH, JNMC, Sawangi (Meghe), Wardha from June 2017 to July 2017. Study included 50 cases and 50 age and sex matched healthy controls.

The observations and results of this study were as follows

Table 1: Baseline characteristics of cases and controls

PARAMETERS	N±SDIN CASES (n=50)	MEAN ± SD IN CONTROLS (n=50)	HI-SQUARE VALUE ($\chi 2$)	p-VALUE
AGE (years)	39.52 ± 9.17	41.5 ± 8.9	4.16	0.057, NS
GENDER MALE FEMALE	 29 21	 29 21	0	1, NS
F/H/O DM	27 (54%)	19 (38%)	2.57	0.10, NS
BMI (kg/m^2)	24.3 ±1.78	22.97 ± 1.94	8.38	0.038, S
WHR MALE FEMALE	 0.90±0.02 0.87±0.03	 0.88±0.02 0.85±0.03	 2.18 1.24	 005, S 6, NS
SBP (mmHg)	127.28 ± 7.13	125.48 ± 7.72	0.54	0.46, NS
DBP (mmHg)	82 ± 5.64	80.43 ± 5.45	1.97	0.16, NS
Serumcholesterol (mg/dL)	183.32 ± 24.98	165.98±26.73	6.83	0.009, S
Serum triglycerides (mg/dL)	139.9 ± 33.41	113.62±33.82	20.54	0.0001, S
Serum LDL (mg/dL)	139.08 ± 24.13	113.46±27.72	5.31	0.021, S
Serum VLDL (mg/dL)	36.02 ± 6.46	34.36 ± 6.88	1.96	0.16, NS
Serum HDL (mg/dL)	43.76 ± 11.33	47.46 ± 15.47	0.16	0.38, NS
MPI	0.43 ±0.03	0.42 ±0.02	17.99	0.0001, S

Table 1 shows cases and controls were age and sex match. BMI, male WHR, serum cholesterol, TG, LDL and MPI was significantly higher and HDL was lower in prediabetics as compared to controls.

Table 2. Distribution of MPI in Cases and Controls

MPI	**CASES(n=50)**	**CONTROLS(n=50)**	***χ2*-value**
≤ 0.44	18(36%)	39(78%)	17.99 p=0.0001, S
>0.44	32(64%)	11(22%)	
TOTAL	50(100%)	50(100%)	
MEAN ± SD	0.43 ± 0.03	0.42 ± 0.02	
Odd's Ratio	4.51(95% CI=1.88-10.79)		

Table 2 shows mean value of MPI amongst cases was 0.43 ± 0.03. Amongst controls, mean value of MPI was 0.42 ± 0.02. Mean MPI for cases was more than controls. Chi-square value was 17.99, Odd's ratio was 4.51 and p-value was 0.0001 ($p < 0.05$) i.e., statistically significant. (Table 12 and Graph 11)

Table 3: Correlation between MPI and cardiovascular risk factors

Parameter	Mean	Std. Deviation	N	lation 'r'	p-value
MPI	0.43	0.03	50	-	-
BMI (kg/m^2)	24.30	1.78	50	-0.116	0.421, NS
WHR	0.89	0.03	50	-0.058	0.689, NS
SBP (mmHg)	127.28	7.13	50	0.097	0.503, NS
DBP (mmHg)	82.00	5.64	50	-0.065	0.653, NS
FBS (mg/dL)	116.86	4.98	50	0.071	0.626, NS
2h-OGTT (mg/dL)	152.14	17.01	50	0.253	0.076, NS
TC (mg/dL)	183.32	24.98	50	0.142	0.326, NS
TG (mg/dL)	139.90	33.41	50	0.203	0.160, NS
HDL (mg/dL)	43.76	11.33	50	-0.091	0.530, NS
LDL (mg/dL)	139.08	24.13	50	0.076	0.598, NS
VLDL (mg/dL)	36.02	6.46	50	0.093	0.521, NS
$IVRT_m$ (ms)	73.76	5.56	50	-0.137	0.343, NS
$IVCT_m$ (ms)	59.52	8.11	50	-0.059	0.686, NS
ET_m (ms)	305.82	21.78	50	-0.093	0.521, NS

Table 3 shows no correlation between MPI and cardiovascular risk factors.

Discussion:

The study was carried out in the Department of Medicine, JNMC, AVBRH, Sawangi (Meghe), Wardha, Maharashtra from June 2017 to July 2017.

The study included 50 cases and 50 age and sex matched healthy controls. The discussion of this study are as follows:

Family history of diabetes mellitus: In this study, we found that majority of patients with prediabetes had a history of diabetes mellitus in the family. However, there is no study in literature which has mentioned family history of diabetes in prediabetic patients.

Body mass index: In this study, a significant amount of patients with prediabetes were overweight as compared to normal subjects ($p<0.05$). However, Murat Akçay, et al. reported that there was no significant difference between BMI in prediabetic patients and normal subjects. [8]

Waist-hip ratio: In this study, there was a significant difference between WHR of males amongst prediabetics as compared to normal subjects ($p<0.05$). WHR of females was also higher in prediabetics but this difference was not significant. However, there is no study in literature which has mentioned WHR in prediabetic patients and normal subjects.

Total cholesterol, Triglycerides and Low-density lipoprotein: In this study, there was a significant difference in mean total cholesterol, triglycerides and low-density lipoprotein for prediabetics as compared to normal subjects. However, Murat Akçay, et al. observed no significant difference within their study population with respect to these parameters ($p<0.05$). [8]

High-density lipoprotein: In this study, the mean value of high-density lipoprotein was lower in prediabetics as compared to normal subjects but this difference was non-significant. However, Murat Akçay, et al. reported that there was no significant difference between HDL levels in prediabetic patients and normal subjects. [8]

Very low-density lipoprotein: In this study, although mean value of very low-density lipoprotein was higher in prediabetes as compared to normal subjects, the difference

was non-significant. However, we did not find any study suggesting direct relationship between very low-density lipoprotein and prediabetes in the literature.

Myocardial performance index: In this study, mean value of MPI in prediabetics was significantly higher as compared to normal subjects ($p<0.05$). Similarly, Murat Akçay et al., also observed that MPI was significantly higher in prediabetic patients as compared to normal subjects in their study population. [(8)]

Correlation of MPI with cardiovascular risk factors: There is no correlation between MPI and cardiovascular risk factors in this study.

Conclusion:

BMI was significantly higher in cases as compared to controls.

- Male WHR was significantly higher in cases as compared to controls. Female WHR was also higher in cases as compared to controls, however, this was non-significant.
- Serum cholesterol, triglycerides and LDL was significantly higher in cases as compared to controls
- Serum VLDL was higher in cases as compared to controls. However, this was non-significant.
- Serum HDL was lower in cases as compared to controls. However, this was non-significant.
- MPI was significantly higher in cases as compared to controls.
- There was no significant correlation between MPI and other cardiovascular risk factors.

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