ASSESSMENT OF CARDIOVASCULAR MORBIDITIES IN PREDIABETIC INDIVIDUALS - A COMPARATIVE CROSS SECTIONAL STUDY

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ABSTRACT

Background: Prediabetes is a disorder of glucose homeostasis characterized by impaired glucose tolerance or impaired fasting glucose. Prediabetes is associated with structural RA and RV changes, and impaired RV systolic and diastolic function, independent of cardiovascular risk factors. Prediabetics are at increased risk of developing type 2 DM. Present study was aimed to assess cardiovascular morbidities in prediabetic individuals.

Material & Method: This hospital based analytical comparative study was conducted among the individuals attending the medicine OPD of Aarupadai Veedu Medical College & Hospital aged more than 18 yrs with impaired fasting glucose and healthy controls. Comparison between Venous Blood Glucose Levels(Fasting, Impaired Glucose Tolerance) and changes in Electrocardiography, Echocardiography were done.Patients with pre-diagnosed cardiac disease, pancreatic disease, chronic kidney disease, thyroid disorders, dyslipidaemia, obese persons and pregnant women were excluded from the study. All the collected data were analysed using SPSS v21 operating on windows 10, with $p < 0.05$ considered statistically significant.

Results: Total 252 participants included among them assessment of the cardiovascular morbidities were done, There were significant higher incidence of ECG and 2D ECHO changes among prediabetic compared to the controls. The ECG and 2D ECHO abnormal findings were seen in 71.5% among the prediabetic cases and zero % in controls.($p < 0.05$). Mean weight of cases was significantly higher than controls, BMI was significantly higher in cases compared to controls. ($p < 0.05$)

Conclusion: Present study concludes that there is higher incidence of cardiovascular morbidities among the Prediabetes individuals compared with normoglycemic healthy individuals.

Keyword: Pre-diabetes, Cardiovascular disease, ECHO, ECG, Ventricular dysfunction.

Introduction

The **world health organization** (WHO) has defined prediabetes as a state of intermediate hyperglycemia with, impaired fasting glucose (IFG) i.e fasting plasma glucose (FPG) of (110

to 125 mg/dL) and impaired glucose tolerance (IGT) i.e 2 h plasma glucose of (140-200 mg/dL) after consuming 75 g of oral glucose or 2 h oral glucose tolerance test (OGTT).[4,5]
While cross-sectional studies have demonstrated an increased prevalence of coronary heart disease in those with prediabetes, this association may be muddled by the fact that cardiovascular illnesses and prediabetes share risk factors.[5]

Prediabetes is associated with structural RA and RV changes, and impaired RV systolic and diastolic function, independent of cardiovascular risk factors. This suggests that prediabetes affects RA and RV structure and function due to direct myocardial involvement.[25]

Present study was aimed to assess risk of development of cardiovascular morbidities in prediabetic individuals with ECG,2D ECHO

Material & Method:

This hospital based analytical comparative study was conducted from October 2020 to October 2022 among the individuals attending the medicine OPD of Aarupadai Veedu Medical College & Hospital aged more than 18 yrs with impaired fasting glucose and healthy controls. Comparison between Venous Blood Glucose Levels(Fasting,Impaired Glucose Tolerance) and changes in Electrocardiography, Echocardiography were done.Patients with pre-diagnosed cardiac disease, pancreatic disease, chronic kidney disease, thyroid disorders, dyslipidaemia, obese persons and pregnant women were excluded from the study. After informed and written consent from patients,detailed history,clinical assessment and lab investigations were done.All data collected by investigator was analysed by SPSS v21 on windows 10.

Result:

In present study total of 252 patients fulfilling inclusion criteria are included after obtaining the informed consent. Patients were grouped as cases with prediabetes and controls as the healthy individuals. There were significant higher incidence of ECG changes and 2D ECHO Changes among the prediabetic cases i.e 71 % and zero % in controls. ($p<0.05$). Mean weight of cases was significantly higher than in controls, BMI was significantly higher in cases compared to controls. ($p<0.05$)

Table 1: Comparison of the ECG and 2D ECHO between the groups

		Control		Case		Chi-square
		Count	N %	Count	N %	(p-value)
ECG Changes	Absent	126	100.0%	36	28.5%	141.80 (0.01)*
	Present	0	0.0%	90	71.5%	
2D ECHO	Normal	126	100.0%	36	28.5%	141.804(0.01)*
	Abnormal	0	0.0%	90	71.5%	

Table 2: Mean comparison between the groups

	Control		Case		p-value
	Mean	SD	Mean	SD	
Weight in KG	58.7	5.9	73.2	14.0	0.01*
Height in cms	158.9	5.2	161.6	8.5	0.01*
BMI	23.2	1.3	28.0	2.6	0.01*

On comparison of the study variables, the mean weight of cases was significantly higher than in controls, similarly BMI was significantly higher in cases compared to controls. ($p<0.05$)

Discussion:

Both Prediabetes and Diabetes leads to Cardiovascular Complicationslike Right Atrial and Ventricular Dysfunction, Left Atrial and Ventricular Dysfunction, Myocardial Ischemia and Infraction, Coronary Atherosclerosis.

Benefits of diagnosing prediabetic patients are as follows –

Better patient outcomes**:**Lifestyle changes results in 7% weight loss and increased physical activity/exercise can improve patient's health related issues

Help them to reduce medicine needed to control high blood pressure and cholesterol and avoid psychosocial stress because of development of Type 2 Diabetes.

Cost-effectiveness**:** Interventions for Prediabetes are highly cost-effective.

Improved population health: Successful help to patients with Prediabetes to attain normal blood glucose levels or prevent or delay progression to type 2 diabetes will reduce future demands on health care system.

In similar to present study Gupta S et al., found that none of the control subjects had an abnormal ECG, but 26% of asymptomatic diabetics had an abnormal ECG. Most asymptomatic individuals with ECG changes had

diabetes mellitus for 5-10 years; 70% of patients with ECG changes had poor glycemic control, elevated triglyceride levels, and reduced High Density Lipoprotein (HDL) values. ST-T alterations were the most often seen anomaly, followed by Left Atrial Enlargement (LAE), Left Ventricular Hypertrophy (LVH), Left Bundle Branch Block (LBBB), and Right Bundle Branch Block (RBBB). A percent of asymptomatic Type 2 DM patients had ECG abnormalities. Nonspecific ST-T alterations, LVH, and LAE, on the other hand, are rather prevalent.[17]

Compared with normoglycemia, Prediabetes (impaired glucose tolerance or impaired fasting glucose according to IFG-WHO criteria) was associated with an increased risk of cardiovascular disease. according to this study Prediabetes is associated with structural RA and RV changes, and impaired RV systolic and diastolic function, independent of cardiovascular risk factors. This suggests that prediabetes affects RA and RV structure and function due to direct myocardial involvement.[24]

According to study by American society of echocardiography, Clinical and standard echocardiographic characteristics mean early diastolic tissue velocity and mean strain rates were statistically lower in prediabetes patients.[25-27]

According to study by Cosentino et al., LV diastolic function estimated by transmitral E/A ratio was significantly impaired in prediabetic patients compared with controls. Prediabetic patients have decreased 2D LV longitudinal strain, as well as 3D longitudinal and area strain.[28-31]

Conclusion:

Present study concludes presence of higher incidence of cardiovascular morbidities among the Prediabetes individuals compared with normoglycemic healthy individuals. There are significant changes detected on the ECG and 2D ECHO among the Prediabetes individuals. Hence it is necessary to screen high-risk individuals for Prediabetes and assess the cardiovascular morbidities so that the treatment strategies can be planned at early stage of disease.

Reference:

1.   American Diabetes Association. Diagnosis and classification of diabetes mellitus. Diabetes care. 2009 Jan 1;32(Supplement_1):S62-7.

2.   Care D. Classification and diagnosis of diabetes. Diabetes Care. 2016 Jan 1;39(1):S13-22.

3.   Carrillo- Larco RM, Barengo NC, Albitres- Flores L, Bernabe- Ortiz A. The risk of mortality among people with type 2 diabetes in Latin America: A systematic review and meta- analysis of population- based cohort studies. Diabetes/metabolism research and reviews. 2019 May;35(4):e3139.

4.   World Health Organization. Definition and diagnosis of diabetes mellitus and

intermediate hyperglycaemia: report of a WHO/IDF consultation.

5. Bansal N. Prediabetes diagnosis and treatment: A review. World journal of diabetes. 2015 Mar 15;6(2):296.

6. American Diabetes Association. Diagnosis and classification of diabetes mellitus. Diabetes care. 2014 Jan 1;37(Supplement_1):S81-90.

7. Libman IM, Barinas-Mitchell E, Bartucci A, Robertson R, Arslanian S. Reproducibility of the oral glucose tolerance test in overweight children. The Journal of Clinical Endocrinology & Metabolism. 2008 Nov 1;93(11):4231-7.

8. Balion CM, Raina PS, Gerstein HC, Santaguida PL, Morrison KM, Booker L, Hunt DL. Reproducibility of impaired glucose tolerance (IGT) and impaired fasting glucose (IFG) classification: a systematic review.

9. Genuth S, Kahn R. A step backward—or is it forward?. Diabetes Care. 2008 Jun 1;31(6):10936.

10. Cohen RM, Snieder H, Lindsell CJ, Beyan H, Hawa MI, Blinko S, Edwards R, Spector TD, Leslie RD. Evidence for independent heritability of the glycation gap (glycosylation gap) fraction of HbA1c in nondiabetic twins. Diabetes care. 2006 Aug 1;29(8):1739-43.

11. Bloomgarden ZT, Inzucchi SE, Karnieli E, Le Roith D. The proposed terminology 'A1c-derived average glucose'is inherently imprecise and should not be adopted. Diabetologia. 2008 Jul;51(7):1111-4.

12. Danaei G, Finucane MM, Lu Y, Singh GM, Cowan MJ, Paciorek CJ, Lin JK, Farzadfar F, Khang YH, Stevens GA, Rao M. National, regional, and global trends in fasting plasma glucose and diabetes prevalence since 1980: systematic analysis of health examination surveys and epidemiological studies with 370 country-years and 2· 7 million participants. The lancet. 2011 Jul 2;378(9785):31-40.

13. Nguyen QC, Whitsel EA, Tabor JW, Cuthbertson CC, Wener MH, Potter AJ, Halpern CT, Killeya-Jones LA, Hussey JM, Suchindran C, Harris KM. Blood spot–based measures of glucose homeostasis and diabetes prevalence in a nationally representative population of young US adults. Annals of epidemiology. 2014 Dec 1;24(12):903-9.

14. Aladhab RA, Alabbood MH. Adherence of patients with diabetes to a lifestyle advice and management plan in Basra, Southern Iraq. Dubai Diabetes and Endocrinology Journal. 2019;25(3-4):100-5.

15. Gupta S, Arora YK, Sharma N. Prevalence of Diabetes and Prediabetes (Impaired Fasting Glucose and/or Impaired Glucose Tolerance) in Rural Population of Niwari Area of District Ghaziabad in India. Journal of Orofacial & Health Sciences.

2015;6(1):36-9.

16.   PRITI R, SEELI M. EFFECTIVENESS OF STRUCTURED TEACHING PROGRAM ON KNOWLEDGE REGARDING PREDIABETES AND ITS PREVENTION. Asian Journal of Advances in Medical Science. 2022 Mar 21:1-4.

17.   Gupta S, Gupta RK, KulShReStha M, ChaudhaRy RR. Evaluation of ECG abnormalities in patients with asymptomatic type 2 diabetes mellitus. Journal of clinical and diagnostic research: JCDR. 2017 Apr;11(4):OC39.

18.   Lorenzo C, Wagenknecht LE, Hanley AJ, Rewers MJ, Karter AJ, Haffner SM. A1C between 5.7 and 6.4% as a marker for identifying pre-diabetes, insulin sensitivity and secretion, and cardiovascular risk factors: the Insulin Resistance Atherosclerosis Study (IRAS). Diabetes care. 2010 Sep 1;33(9):2104-9.

19.   Huang D, Refaat M, Mohammedi K, Jayyousi A, Al Suwaidi J, Abi Khalil C. Macrovascular complications in patients with diabetes and prediabetes. BioMed research international. 2017 Oct;2017.

20.   Gupta AK, Greenway FL, Cornelissen G, Pan W, Halberg F. Prediabetes is associated with abnormal circadian blood pressure variability. Journal of human hypertension. 2008 Sep;22(9):627-33.

21.   Palladino R, Tabak AG, Khunti K, Valabhji J, Majeed A, Millett C, Vamos EP. Association between pre-diabetes and microvascular and macrovascular disease in newly diagnosed type 2 diabetes. BMJ Open Diabetes Research and Care. 2020 Apr 1;8(1):e001061.

22.   Huang Y, Cai X, Mai W, Li M, Hu Y. Association between prediabetes and risk of cardiovascular disease and all cause mortality: systematic review and meta-analysis. Bmj. 2016 Nov 23;355.

23.   Cai X, Zhang Y, Li M, Wu JHY, Mai L, Li J, et al. Association between prediabetes and risk of all cause mortality and cardiovascular disease: updated meta-analysis. Bmj. 2020;370.

24.   Linssen PB, Veugen MG, Henry R, van Der Kallen CJ, Kroon AA, Schram MT, Rocca BL, Stehouwer CD. Associations of (pre) diabetes with right ventricular and atrial structure and function: the Maastricht Study. Cardiovascular diabetology. 2020 Dec;19(1):1-2.

25.   Ernande L, Audureau E, Jellis CL, Bergerot C, Henegar C, Sawaki D, et al. Clinical implications of echocardiographic phenotypes of patients with diabetes mellitus. J Am Coll Cardiol. 2017;70(14):1704–16.

26.   Ford ES, Zhao G, Li C. Pre-diabetes and the risk for cardiovascular disease: a systematic review of the evidence. J Am Coll Cardiol. 2010;55(13):1310–7.

27.   Niiranen TJ, Kalesan B, Hamburg NM, Benjamin EJ, Mitchell GF, Vasan RS. Relative contributions of arterial stiffness and hypertension to cardiovascular disease: the Framingham Heart Study. Journal of the American Heart Association. 2016 Oct 26;5(11):e004271.

28.   Vukomanovic V, Tadic M, Suzic-Lazic J, Kocijancic V, Celic V. The relationship between heart rate variability and left ventricular layer-specific deformation in uncomplicated diabetic patients. Int J Cardiovasc Imaging. 2017;33(4):481–90.

29.   Mahfouz RA, Moustafa TM, Goda M, Gad M. Atrial electromechanical delay, and left ventricular strain in pre-diabetic patients. IJC Metab Endocr. 2017;14:1–5.

30.   Georgievska-Ismail L, Zafirovska P, Hristovski Z. Evaluation of the role of left atrial strain using two-dimensional speckle tracking echocardiography in patients with diabetes mellitus and heart failure with preserved left ventricular ejection fraction. Diabetes Vasc Dis Res. 2016;13(6):384–94.

31.   Arrieta F, Iglesias P, Pedro-Botet J, Becerra A, Ortega E, Obaya JC, et al. Diabetes mellitus and cardiovascular risk: Update of the recommendations of the Diabetes and Cardiovascular Disease working group of the Spanish Diabetes Society (SED, 2018). Clínica e Investig en Arterioscler (English Ed. 2018;30(3):137–53.

32.   Tabák AG, Herder C, Rathmann W, Brunner EJ, Kivimäki M. Prediabetes: a high-risk state for diabetes development. Lancet. 2012;379(9833):2279–90.

33.   Hu H, Mizoue T, Sasaki N, Ogasawara T, Tomita K, Nagahama S, et al. Prediabetes and cardiovascular disease risk: a nested case-control study. Atherosclerosis. 2018;278:1–6.