OPEN AIMJ ORIGINAL ARTICLE

Internal Medicine

Study Of Medical Complications In Prediabetics

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Received *for publication November 26,2021;****Accepted*** *March 24, 2022;* ***Published online*** *March 24, 2022.*

doi: 10.21608/aimj.2022.107289.1676

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ABSTRACT

Background: The efficacy of detecting people with pre-diabetes in order to avoid T2D has been extensively debated. Clinical trials showing that lifestyle changes and drug-based therapies can prevent or delay T2D progression give some solid evidence.
Aim of the work: To study early and discover early complications either microvascular or macrovascular in both patients of prediabetes and medical syndrome.
Patients and methods: This study was a prospective case control study carried out at Al-hussein university hospital. This study included 30 patients with prediabetes (group A), 50 patients with type 2 DM (group B), and 50 healthy controls (group c). Diabetics and prediabetics had significantly higher mean of age and BMI than control group.
Results: There is a significant difference between the two groups (prediabetes and diabetes) regarding retinopathy, neuropathy, nephropathy, hyperlipidemia and hypertension.
Conclusion: Through complicated molecular mechanisms involving hyperglycemia and insulin resistance, both diabetics and prediabetes predispose people to developing diabetes complications. Whereas intense glycemic control alone will not decrease deaths and major events, a comprehensive strategy that includes lifestyle changes, lowering hyperglycemia, and addressing cardiovascular risk factors linked with diabetes is helpful to those patients' cardiovascular risk profile; thus, blood glucose control targets must be adjusted to the individual patients' needs.

Keywords: *Insulin Resistance; Macrovascular; Microvascular; Prediabetes; Type 2 Diabetes.*

Disclosure: *The author has no financial interest to declare in relation to the content of this article. The Article Processing Charge was paid for by the authors.*
Authorship: *The author has a substantial contribution to the article.*

INTRODUCTION

People with "prediabetes" have blood sugar levels that are too high to be deemed normal but may not meet the diabetes criteria. Individuals experiencing prediabetes have IFG and/or IGT, as well as an A1C of 5.7–6.4% (39–47 mmol/mol). [1]

IFG and IGT are abnormal glycemic control transitional phases that happen between normal glucose homeostasis and T2D. [3] In the short term, prediabetes increases the risk of T2D by three to ten times. [3]

T2D pathophysiology involves a broad range of organ systems, with various abnormalities playing a role in the prediabetes development into type 2 diabetes. T2D is caused by three basic defects: Poor beta-cell insulin secretion, poor insulin action in muscle, and higher liver glucose production. [4]

Patients having IGT had a higher risk of death from any cause when compared to age-matched normoglycemic controls.

Prediabetic conditions, defined as impaired fasting glycaemia (IFG) or impaired glucose tolerance (IGT), are linked to an increased risk of cardiovascular disease morbidity and death [5]

Insulin resistance and obesity, even in non-diabetic people, raise the danger of myocardial infarction [6]

The DECODE (Diabetes Epidemiology: Collaborative Analysis of Diagnostic Criteria in Europe) study discovered a link between fasting plasma glucose and CVD-related death regardless of diabetic status. A "J-shaped" curve appeared to exist between fasting plasma glucose and CVD-associated death, with no threshold impact detected at high levels of glucose.[1]

In a prospective study of patients treated for an acute coronary syndrome, 36% were shown to possess IGT and 22% had prior undetected diabetes. [7]

Because some individuals with prediabetes can potentially have not only macrovascular diabetes complications like CVD, but also microvascular

complications, it is critical to manage prediabetes with the aim of normalizing blood sugar levels and, in particular, preventing the advancement of Type-2 diabetes [8]

According to nerve conduction investigations, neuropathy is evident in 10–18% of diabetic patients at the diagnosis time [9]

Patients having prediabetes seem to be at a greater risk of the development of diabetic nephropathy as well as concurrent CKD [10]

Several researchers' clinical trials on retinopathy have revealed lower visual acuity as well as contrast sensitivity in people with IGT [11]

Independent investigations have found that the frequency of retinopathy in Pima Indians having IGT is almost fourfold higher than in age-matched control participants [12]

Numerous disruptions in lipoprotein metabolism occur in people with prediabetes as a result of diverse combination of insulin shortage, insulin resistance, and hyperglycemia [3]

The aim of this work was to study and early discover early complications either microvascular or macrovascular in both patients of prediabetes and medical syndrome.

PATIENTS AND METHODS

This research was conducted at Al-Hussein University Hospital as a prospective case control study. This study will comprise 30 patients with prediabetes (group A), 50 patients with T2DM (group B), and 50 healthy controls (group c). All subjects' ages will range between 20 and 65 years. Group A: Thirty patients with prediabetes were diagnosed using the (American Diabetes Association) criteria and included. Group B: Fifty patients with DM type 2 diagnosed as per the (American Diabetes Association) criteria was studied. Group c: Additionally fifty sex and age-matched healthy volunteers with no Diabetes or prediabetes was recruited as healthy control group.

Exclusion criteria: The study excluded participants who had current renal or liver disease, malignancies, any acute inflammation or infection, and current clinically severe CVD.

Methods: Thorough history and clinical examination was reported for all groups including drug history and BMI (body mass index). Every patient had 15 mL of venous blood drawn.5 ml of venous blood serum was collected in plain tubes to perform the following tests using automated chemistry analyzer machine (Cobas c311): 8-h Fasting blood sugar , 2-h postprandial blood sugar, alanine aminotransferase (ALT), aspartate aminotransferase (AST), lipid profile and S.creat. HbA1C which was performed using HPLC technique on LD-500 HbA1c Analyzer. e-GFR was calculated based on Cockcroft-Gault Formula, CBC on Sysmex XP-300 Automated 3-part differential hematology analyzer , ESR by fast detector, CRP by latex technique, albumin/creatinine ratio for early detection of diabetic nephropathy, , ECG, fundus examination and nerve conduction test if indicated.

Ethics and patient consent: All procedures of the study will follow the Al-Azhar University committee regulations and patient consent has been obtained from all subjects involved in the research.

Statistical analysis: The Statistical Package for Social Sciences (SPSS) version 16.0 was used for statistical analyses. The data is expressed as a mean ± SD. A Mann–Whitney U or Friedman test was used to determine differences between the two groups. To examine the differences between the three groups, ANOVA or the Kruskal–Wallis test were used.

The correlation coefficients were analyzed using Spearman's rank sum test, with a p-value of < 0.05 deemed significant.

RESULTS

		Prediabetics (N=30)	Diabetics (N=50)	Control (N=50)	F	P
Age (years) Mean ± SD		55.13 ± 8.07	52.71± 9.66	46.67 ± 11.92	**5.68**	**.005**
Sex	Male	12 (40%)	10 (33.3%)	17 (56.7%)	χ^2	.171
	Female	18 (60%)	20 (66.7%)	13 (43.3%)	3.53	
BMI (kg/m^2) Mean ± SD		26.82 ± 2.39	28.88 ± 1.43	24.53 ± 2.74	**25.6**	**.000**
DM duration (years) Mean ± SD		--	6.48 ± 2.63	--	--	--

Table 1: Demographic data for the three groups studied

When it comes to age and BMI, there is a significant difference between the three study groups (Table 1)

	Prediabetics (N=30)	Diabetics (N=50)	Control (N=50)	F	P
FBS (mg/dl) Mean ± SD	109.13 ± 6.88	147.75 ± 35.41	83.63 ± 12.88	11.9	.000
2hPP (mg/dl) Mean± SD	173.19 ± 16.32	261.23 ± 82.46	127.57 ± 8.55	40	.000
HbA1c Mean ± SD	5.91± .21	8.62 ± 1.54	5.18 ± .205	46	.000

Table 2: Diabetes parameters between the three studied groups

There is a highly significant difference between the three study groups regarding FBS, 2hPP, and HbA1c. (Table 2)

	Prediabetics (N=30)	Diabetics (N=50)	Control (N=50)	F	P
Total Cholesterol (mg/dl) Mean± SD	208.12 ± 28.6	240.65 ± 32.06	141.1 ± 25.2	**93**	**.000**
Triglycerides (mg/dl) Mean± SD	124.17 ± 22.61	150.8 ± 57.76	100.27 ± 16.49	**14**	**.000**
LDL (mg/dl) Mean± SD	102.89 ± 19.63	131.03 ± 20.82	97.44 ± 14.28	**29**	**.000**
HDL (mg/dl) Mean± SD	48.14 ± 7.45	30.08 ± 6.95	53.9 ± 11.43	**59**	**.000**

Table 3: Lipid profile between the three studied groups

There is a highly significant difference between the three studied groups regarding total cholesterol, triglycerides, LDL and HDL. (Table 3)

	Prediabetics (N=30)	Diabetics (N=50)	Control (N=50)	F	P
T. bilirubin (mg/dl) Median (Range)	0.84 (0.42 – 1.1)	0.86 (0.46 - 1.3)	0.8 (0.32 - 1.1)	.765	.185
ALT (U/L) Mean± SD	28.76 ± 7.11	28.48 ± 7.34	27.31 ± 5.76	.387	.681
AST (U/L) Mean± SD	28. 29 ± 7.41	29.37± 7.66	27.47 ± 6.33	.532	.589
Albumin (g/dl) Mean± SD	4.09 ± 0.613	4.11 ± 0.555	4.15 ± 0.534	.067	.917
Creatinine (mg/dl) Median (Range)	1 (0.7 - 1.2)	1 (0.8 - 1.2)	0.9 (0.7 - 1.1)	.392	.676
Urea (mg/dL) Mean ± SD	18.54 ± 4.31	21.25 ± 8.83	15.47 ± 3.6	**4.71**	**.011**
CRP (U/L) Mean ± SD	10.33 ± 6.38	23.48 ± 16.46	8.67 ± 3.25	**18.4**	**.000**

Table 4: Liver and renal parameters between the three studied groups

There is a significant difference between the three studied groups regarding urea and CRP. (Table 4)

	Prediabetics (N=30)	Diabetics (N=50)	X^2	P
Retinal complications	1 (3.3%)	10 (20%)	**4.04**	**.044**
Neurological complications	0	10 (32%)	**12**	**.001**
Coronary complications	0	5 (10%)	3.16	.076
Peripheral complications	3 (10%)	13(26.7%)	2.78	.095
Nephropathy	0	12 (24%)	**7.93**	**.005**
Hyperlipidemia	6 (20%)	28 (56%)	**8.53**	**.003**
Hypertension	9 (30%)	35 (70%)	**9.6**	**.002**

Table 5: Frequency of complications between the prediabetics and diabetics groups

There is a significant difference between the two groups regarding retinopathy, neuropathy, nephropathy, hyperlipidemia and hypertension. (Table 5)

DISCUSSION

The efficacy of detecting people with pre-diabetes in order to avoid T2D has been extensively debated. Clinical trials showing that lifestyle changes and drug-based therapies can prevent or delay T2D progression give some solid evidence .[13]

However, detractors claim that only a subgroup of people with pre-diabetes would acquire T2D, and that the population advantages of interventions are exceeded by the possible bad consequences of over-testing, unneeded medicalization, and doubts about the efficacy of preventative techniques outside of the study setting, among other considerations.[14]

Different organizations have adopted different criteria for a diagnosis, which have been revised regularly throughout time .[15]

Diverse diagnostic criteria identify variable groups of people with different rates of progression to T2D and risk of morbidity, prompting the question of if those that may profit the most from strict clinical treatment are efficiently defined as greater risk by each of the criteria.[16]

Pre-diabetes was demonstrated to have a role in the progression of macrovascular dysfunction, which could help to explain why people with pre-diabetes and T2D have a greater risk of cardiovascular disease-morbidity and death.[17]

People with pre-diabetes have been documented to have initial phases of retinopathy, neuropathy, and nephropathy, which are often milder types than those observed in established T2D, and preventative studies have shown that their risk can be lowered with lifestyle changes. [18]

This has crucial implications for preventative efforts as well as if glycemic testing and the identification of pre-diabetes in real-world situations influence the progression of microvascular and macrovascular disease in those who go on to acquire T2D .[19]

So this study aim was to study and early discover early complications either microvascular or macrovascular in both patients of prediabetes and medical syndrome.

This case control study included 30 patients with prediabetes (group A), 50 patients with T2DM (group B), and 50 healthy controls (group c). Diabetics and prediabetics had significantly higher mean of age and BMI than control group.

Obesity has long been known as a primary contributor to insulin resistance and T2DM.[20]

The current study found that diabetic group had the highest mean of FBS, 2hPP and HA1C followed by prediabetic group with statistical significant difference. In terms of 2hPP and HbA1c, post-hoc analysis showed a significant difference between the groups of prediabetics and diabetics.

In agreement with another study in which there is a considerable increase in HbA1c levels with the development of tolerance of normal glucose to prediabetes (IFG and IGT) as well as overt diabetes. When compared to the group having normal glucose tolerance, all groups having altered glucose tolerance—IFG, IGT, and diabetes—had significantly greater HbA1c levels (P\ 0.0001). When compared to newly diagnosed diabetes, both prediabetic states (IFG and IGT) had significantly lower HbA1c; however, the IGT group had significantly higher HbA1c than the IFG group.[21]

In our research, there were highly significant differences in total cholesterol, triglycerides, LDL, and HDL levels amongst the three groups studied. Diabetics had the greatest mean of total cholesterol, triglycerides and LDL level followed by prediatics, while had lowest mean of HDL than other groups followed by prediabetics.

In the Framingham Heart Study, T2DM patients were shown to have lower HDL levels and higher plasma TG levels when compared to non-T2DM patients.[22]

Vineetha et al. found statistically significantly lower HDL levels and higher TG levels in people with Parkinson's disease in a case-control study.[23] Lipid profile abnormalities are thought to be a significant risk factor for T2DM in prediabetic individuals.[24]

In respect of dyslipidemia levels, Bhowmik et al. found findings that were similar to the present research. Their findings revealed a significant link between serum lipid profile and T2DM and Parkinson's disease. Furthermore, the strongest connection with T2DM and PD was shown when high TG levels were combined with low HDL levels. T2DM and PD patients had higher levels of CHOL, TG, and lower levels of HDL.[25]

In the current study, diabetic group had the highest mean of urea and CRP level followed by prediabetics with statistical significant differences.

In line with another study that investigated the relationship between blood urea and creatinine levels and blood sugar levels in diabetic and non-diabetic people to see if they might be used to diagnose diabetic nephropathy and compare them to glycemic state. A total of 18 of the 100 diabetic samples exhibited high urea levels. There has been no one with a high urea level in the 100-sample control group. With increasing blood glucose levels, there had been a statistically significant elevation in urea ($p<0.05$, 95%CI).[26]

This supports the results of prior research that found hyperglycemia to be one of the leading causes of progressive kidney damage .[27]

When the kidneys are damaged, a rise in urea levels is observed. Increased blood urea levels in patients with diabetes with high blood glucose levels indicate renal damage. Anjaneyulu et al. discovered that increased urea and serum creatinine levels in diabetic rats suggest gradual kidney damage.[28]

Another study showed that the levels of CRP can be used as a biomarker in different stages of diabetes .[29]

Only a few studies have linked elevated CRP levels to prediabetes and diabetes.

According to the findings of the Atalar et al. study, CRP levels were statistically greater in the only dysregulated T2D groups compared to the other groups. The cause of the significantly increased CRP levels in dysregulated diabetics is related to the acute inflammation that occurs as a result of diabetes. Chronic inflammation has long been recognized as a significant risk factor for diabetes-related death .[29]

CRP levels have been reported to be a valuable biomarker in diabetics for the early detection of chronic processes. Such studies found that high CRP levels were linked to a higher risk of cardiovascular disease in T2D.[30]

The finding recommends that CRP levels are important in the progression of diabetic patients with chronic inflammation .[29]

In the current research, the diabetic group had a significantly larger percentage of patients with complications as regarding retinopathy (20% vs 3.3%), neuropathy (32% vs 0%), nephropathy (23.3% vs 0%), hyperlipidemia (56.7% vs 20%) and hypertension (70% vs 30%) than prediabetic group with statistical significant differences.

The prevalence of IGT has been linked with a doubling of cardiovascular death in 44–55-year-old

males from the Paris Prospective Study cohort as compared to normoglycemic participants, according to a study.[31]

Moreover, when compared to non-diabetic people, patients who proceed to T2DM have an increased risk of atherosclerotic disorders, leading to an elevated burden of cardiovascular, stroke, and peripheral vascular illnesses.[32]

The majority of people with prediabetes show characteristics of the insulin resistance (metabolic) syndrome, such as hypertriglyceridemia, upper-body obesity, lower HDL cholesterol levels, and high blood pressure, among others. The metabolic syndrome components are often discovered in prediabetic people many years prior to T2DM being diagnosed. [33]

Similar to the Gutenberg Health Study in Germany, which found an 8.1% incidence of retinopathy among people with prediabetes.[34]

In another investigation, microalbuminuria was shown to be prevalent in 15.5% of prediabetic individuals. The retinal hemodynamics and microvascular function of those with prediabetes are also affected. As a result, retinal vasoreactivity tests could be a useful technique for detecting early vascular risk .[35]

Remarkably, signs and symptoms of classical diabetic peripheral polyneuropathy could develop in pre-diabetic individuals. Peripheral neuropathy affects about 11–25% of people with prediabetes. Additionally, prediabetes is linked to autonomic dysfunction, which manifests as decreased heart rates and a higher incidence of erectile dysfunction.[36]

CONCLUSION

through complicated molecular mechanisms involving hyperglycemia and insulin resistance, diabetes and prediabetes both predispose people to developing diabetes complications. Whereas intense glycemic control alone will not decrease deaths and major events, a comprehensive strategy that includes lifestyle changes, lowering hyperglycemia, and addressing cardiovascular risk factors linked with diabetes is helpful to those patients' cardiovascular risk profile; thus, blood glucose control targets must be adjusted to the individual patients' needs.

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