Correlation between microvascular complications and severity of coronary artery disease in patients with type 2 DM

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Abstract

Background: Patients suffering from type 2 diabetes (T2DM) have a 2–6 times higher risk of dying from cardiovascular disease than people without diabetes. While macrovascular disease is the main pathogenic mechanism behind coronary artery disease in the general population, microvascular disease may play a significant role in the development of CAD in diabetics. Coronary artery disease is a leading cause of mortality in diabetics. Microalbuminuria to chronic kidney disease (CKD) can result from diabetic nephropathy, which is caused by persistently poor glycemic management. It is unclear how microalbuminuria and cardiovascular disease are related, but one theory suggests that it has to do with the growing transvascular leakiness of albumin in the systemic and renal arteries. A well-known micro-angiopathic consequence of DM with a strong correlation to cardiovascular risk factors is diabetic retinopathy.

Objectives: To assess the association between the microvascular complications and the severity of CAD determined by coronary angiography in patients with T2DM.

Patients and Methods: This study was conducted on 70 cases with T2DM who were admitted for coronary angiography due to suspected CAD and then divided into 41 patients diagnosed with nephropathic,and 29 non-nephropathy patients. Then Patients were divided into retinopathic and non-retinopathic groups 36 patients diagnosed with retinopathy and 34 non-retinopathic patients. All patients were subjected to full history, clinical examination, lab investigations and cardiac catheterization using the Genseni score system to detect the severity of coronary artery disease.

Results: Gensini score was significantly higher in the nephropathy group compared to the non-nephropathy group. The Vessel score was insignificantly different between the two groups. Gensini score was significantly higher in the retinopathy group compared to the non-retinopathy group. Vessel score was significantly higher in the retinopathy group compared to the non-retinopathy group.

Conclusion: In patients with type 2 DM subjected to coronary angiography because of suspected (CAD), duration of DM, creatinine, HbA1c, and Gensini score were significantly higher in the nephropathic group compared to the non-nephropathic group. Further, duration of DM, HbA1c. Gensini score and vessel score were significantly higher in the retinopathy group compared to the non-retinopathy group. Microvascular diabetic complications with retinopathy and nephropathy were significantly associated with the severity of CAD determined by coronary angiography.

Introduction

Diabetes mellitus (DM) is a leading global cause of morbidity and even mortality, and it has a large financial impact on healthcare. Since type II Diabetes mellitus (T2DM) accounts for around 90% of all occurrences of DM, it is the most prevalent type of DM **(Che et al., 2018).** Cardiovascular causes of death are around six times more likely to occur in people with T2DM. For instance, among white Americans with T2DM, the age-adjusted prevalence of CAD is twice as high as in those without**(Glovaci and Wong, 2019).**The health burden of diabetes is connected to both macrovascular and microvascular problems **(Bruemmer and Nissen, 2020)**. While macro-vascular disease is the main pathogenic mechanism underlying CAD in the general population, microvascular disease may play a significant role in CAD development in diabetics. CAD is a leading cause of mortality in diabetics **(Shereef and Kandeel, 2019).** It appears that angina pectoris may be significantly influenced by coronary microvascular dysfunction. People without coronary arterial disease may experience dangerous effects on the coronary microvasculature that result in myocardial ischemia; CAD causes myocardial ischemia as a result of coronary vasospasm**(Kaski et al., 2018).**Diabetes micro-vascular problems cause a significant rise in morbidity and a significant decrease in quality of life in diabetics **(Dal Canto et al., 2019).**Microalbuminuria to chronic kidney disease (CKD) are examples of diabetic nephropathy, which develops as a result of persistently poor glycemic management. Clinically, end-stage renal disease (ESRD) in the adult population worldwide is most commonly associated with renal illness in T2DM patients **(Van Dieren et al., 2010).** Independent of renal function, urinary albumin excretion (UAE), a measure of endothelial and vascular damage, may be a predictor of coronary artery atherosclerosis **(Ahmed et al., 2018)**.Although the exact mechanism connecting microalbuminuria and cardiovascular disease is not known, it may be linked to an increase in albumin transvascular leakiness in systemic and renal arteries. An indication of severe endothelial dysfunction is albuminuria **(Naidoo, 2002).**

A well-known micro-angiopathic consequence of diabetes mellitus (DM), diabetic retinopathy (DR) has a strong correlation with cardiovascular risk factors **(Van Hecke et al., 2005).** Future use of the diabetic retinopathy count as a CAD predictive tool **(Attia et al., 2020).** The most often described long-term diabetic consequence, affecting up to 40% of T2DM patients, is diabetic peripheral neuropathy (DPN). Previous DPN has been linked to an increased chance of presenting a first cardiovascular incident, according to a study by **Ybarra-Muoz et al. (2016).** The present study aims to assess the association between the microvascular complications and the theseverity of CAD determined by coronary angiography in patients with T2DM.

Patients and Methods

This study is an observational study using consecutive patients who underwent diagnostic coronary angiography in the Catheter Lab Unit of the Internal Medicine Department of Sohag University Hospital from Dec 2020 to Dec 2021.The study included 70 patients who underwent coronary angiography due to suspected coronary artery disease. The selected patients were divided into four groups depending on clinical evaluation, ECG, fundus examination, albumin creatinine ratio, EGFR (CKD-EPI), and renal function test: **Group 1:** 36 patients with diabetic retinopathy. **Group 2:** 34 patients without diabetic retinopathy.**Group 3:** 40 patients with diabetic nephropathy

Group 4: 30 patients without diabetic nephropathy.

1-Inclusion criteria: The study included patients who underwent diagnostic coronary angiography because of suspected coronary artery disease.

2-Exclusion criteria:

1-Type 1 DM.

2- Uncontrolled hypertension (BP≥180/110).

3-Pregnant women.

4-Patient known non-diabetic retinal disease; non-diabetic nephropathy.

Each patient was subjected to the following :

1-A Full history: taking with analysis for risk factors of CAD which included age,sex, smoking,history of DM,history of hypertension, dyslipidemia and family history of CAD.

2-Clinical evaluation: included:-

   A-General medical examination.

   B-local cardiac examination.

   C-Electrocardiography: 12 lead ECG for detection manifestation of ischemia.

   D-Coronary angiography and Genseni score system:The Genseni score and Vessel score are used to determine the severity of coronary artery lesions. Each individual coronary stenosis was given a severity value based on the degree of luminal constriction and the geographic significance of the stenosis in order to determine the Genseni score. Concentric lesions and eccentric plaques were evaluated for

reduction in lumen diameter and radiological appearance (reduction of 25%, 50%, 75%, 90%, 99%, and total occlusion were assigned Genseni scores of 1, 2, 8, 16, and 32, respectively). This score is multiplied by a certinnumber that accounts for the significance of the coronary artery tree's damaged region.For instance, the left main coronary artery receives a rating of 5, the proximal left anterior descending coronary artery receives a rating of 2.5, the proximal left circumflex coronary artery receives a rating of 1.5, the mid-region of the left anterior descending coronary artery receives a rating of 1, the distal left LAD receives a rating of 1, the proximal, mid, distal regions of the left circumflex coronary artery and RCA **0.5** for the second diagonal and postero-lateral branch.

E- Investigations

1-Serum creatinine.

2-Albumin-Creatinine ratio.

3-EGFR (estimated glomular filtration rate) by(CKD- EPI).

4-Glycated hemoglobin (HbA1C).

5-Lipid profile.

6-Fundus examination.

The current study has been approved by the Ethics Committee of the Faculty of Medicine Sohag University – Sohag – Egypt / The ethical approval code: SOU-Med-PRR22- 4 -10-1-212.

Statistical analysis

The IBM SPSS software package Version 20.0 was used to examine the data that were fed into the computer (Armonk, NY: IBM Corp) Numbers and percentages were used to describe the qualitative data. The normality of the distribution was examined using the Kolmogorov-Smirnov test. The range (minimum and maximum), mean, standard deviation, median, and interquartile range were used to characterise quantitative data (IQR). At the 5% level, significance of the results was determined.

Results

This study involved 70 adult T2DM patients who underwent diagnostic coronary angiography at the Sohag University Catheter Unit due to a suspicion of CADfrom Dec 2020 to Dec 2021. The age of the patients who were the subject of the study ranged from 38 to 80 years old, with a mean of 55.83±9.16 years. There were 25 (35.11%) female patients and 45 (64.28%) male patients in the research. The mean duration of DM was 4.44 ± 2.89 years, and 14.5% of the patients had hypertension. The duration of DM ranged from 1.5 to 12 years. 5 (7.14%) patients who smoked, 44 (62.86%) patients who had dyslipidemia, and 13 (18.57%) patients who had a positive family history of CAD (**Table1**).

Table 1. Patient characteristics of the studied patients (n = 70)

Variables	Studied patients (N=70)
Age (years)	55.83± 9.16 ys
Male	45 (64.28%)
Famale	25 (35.11%)
Duration of DM (years)	4.44±2.89ys
Family history	13(18.57%) +ve
Smoking	5(7.14%) +ve
Dyslipidemia	44(62.86%) +ve
Hypertension	14(19.54%)+ve

The Genseni score and vessel score quantify the severity of CAD. Four groups of the selected patients were created:Group 1: 36 patients with diabetic retinopathy. Group2: 34 patients without diabetic retinopathy.Group 3: 40 patients with diabetic nephropathy.Group 4: 30 patients without diabetic nephropathy.

Investigation of the studied patients showed that HbA1C ranged from 4-8 % with a mean value of 5.86± 0.84 %, creatinine ranged from 0.4 - 5.9 mg/dl with a mean value of 1.32 ± 0.88 mg/dl, albumin- creatinine ratio ranged from 5 - 18441 with a median value of 55.50,cholesterol ranged from 50 – 240 mg/dl with a mean value of 135.47 ± 49.79 mg/dl, triglyceride ranged from71– 241 mg/dl with a mean value of 115.28± 43.55 mg/dl, troponin ranged from 0.001-50 ng/ml with a mean value of 8.75±17.23 ng/mL and hemoglobin ranged from 8.5-16.3 gm/dl with a mean value of 12.80±1.67 gm/dl. Estimated Glomerular Filtration Rate ranged from 11 - 153 with a mean value of 72.40 ±

29.69. Fundus abnormality occurred in 36(51.43%) patients and normal 34(57%) patients.

Patients were divided into those with and without nephropathy: Age and sex did not differ significantly between the two nephropathy groups, according to a correlation between these groups and patient characteristics. Smoking, hypertension, dyslipidemia, and family history of CAD were not substantially different between the two groups. When nephropathy and non-nephropathy groups were compared and laboratory tests were performed, it was found that haemoglobin was significantly lower in the nephropathy group than in the non-nephropathy group (P=0.007) and that creatinine was significantly higher in the nephropathy group than in the non-nephropathy group (P=0.003). When compared to the non-nephropathy group, the estimated glomerular filteration rate (eGFR) was considerably lower in the nephropathy group (P<0.001*).When compared to the non-nephropathy group, the nephropathy group's HbA1c was

considerably greater (P=0.044). Cholesterol, triglycerides, and albumin-creatinine ratio were not substantially different between the two groups. In the nephropathy group compared to the non-

nephropathy group, the Gensini score was considerably higher (P=0.034). The difference in vessel score between the two groups was negligible **(Figure 1-2 and Table 2).**

Table 2. Gensini score and vessel score between nephropathy, and non-nephropathy groups of the studied patients.(n = 70)

Variables		Non nephropathy group (n = 29)	Nephropathy group (n = 41)	P value
Gensini score	Median	24	47	**0.034***
	Range	10 – 80	23-169	
Vessel score	0	8 (27.59%)	12(29.27%)	
	1 vessel disease	7 (24.14%)	15(36.59%)	
	2 vessels disease	5 (17.24%)	5(12.20%)	**0.593(NS)**
	3 vessels disease	9 (34.1%)	9(21.95%)	
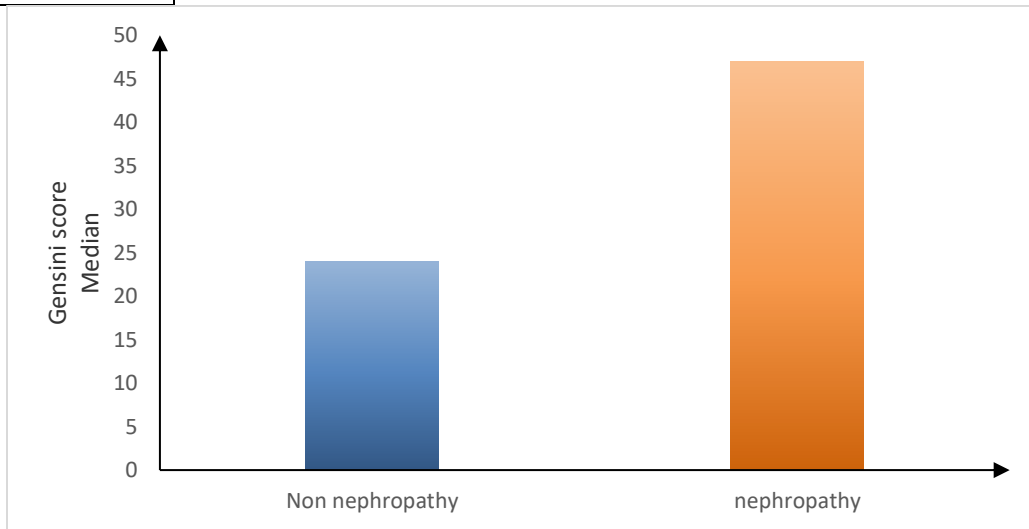
Fig.1.Relationship between nephropathy andGensini score
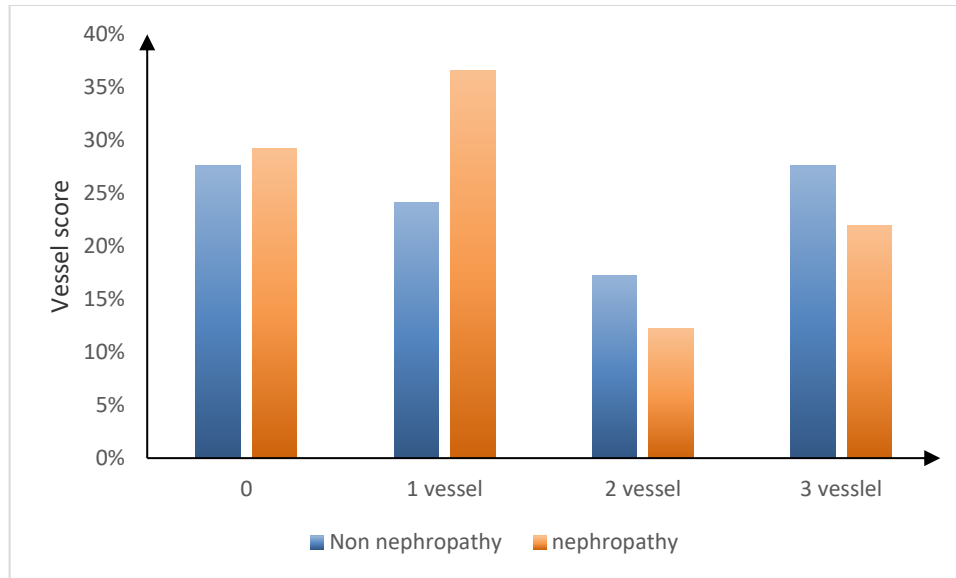
Fig.2 .Relationship between nephropathy,non nephropathy group and vessel score

Relationship between diabetic retinopathy,non-retinopathy groups and patient characteristics.Age, sex, family history of CAD, smoking,Hypertension and dyslipidemia were insignificantly different between the two groups. Duration of DM was significantly higher in the retinopathy group compared to the non-retinopathy group (P<0.01).

Relationship between diabetic retinopathy, non-diabetic retinopathy groups and laboratory investigations: Creatinine, hemoglobin, albumin, creatinine ratio, cholesterol, triglyceride and Estimated Glomerular Filtration Rate were insignificantly different between the two groups. HbA1c was significantly higher in the retinopathy group compared to the non-retinopathy group (P=0.008)Gensini score was significantly higher in the retinopathy group compared to the non-retinopathy group (P=0.028).Vessel score was significantly higher in the retinopathy group compared to the non-retinopathy group (P=<0.001) **(Table 3** and **Fig.3 , 4).**

Table 3. Relationship between Diabetic retinopathy, non Diabetic retinopathy groups and gensini score and vessel score of the studied patients.(n = 70)
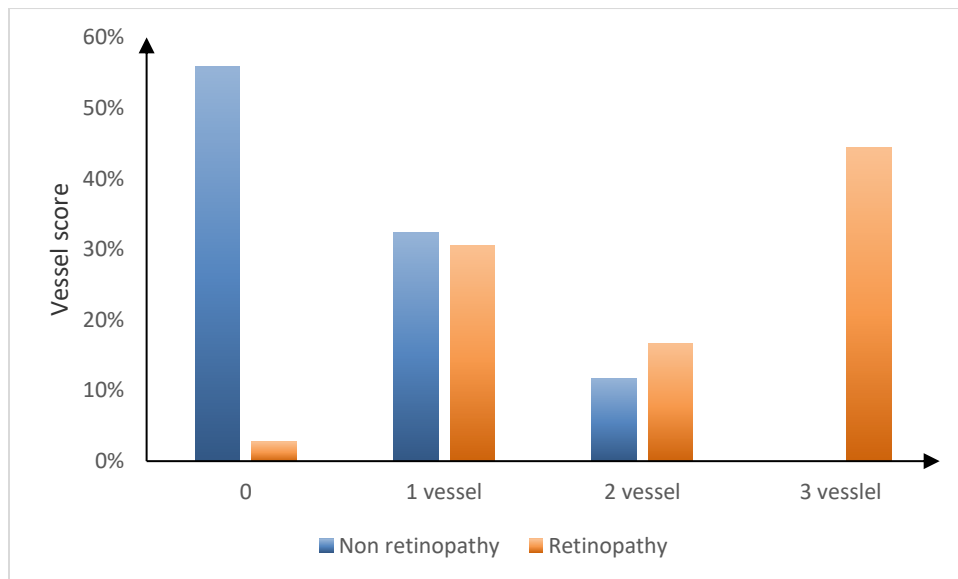
Variables		**Non retinopathy group (n = 34)**	**Retinopathy group (n = 36)**	**P value**
Gensini score	Median	38	48	**0.028***
	Range	16–80	10-169	

vessel score	No	19(55.88%)	1(2.78%)	**P<0.001***
	1 vessel disease	11 (32.35%)	11(30.56%)	
	2vessels disease	4(11.76%)	6(16.67%)	
	3vessels disease	0 (0.00%)	16(44.44%)	

*; significant P value
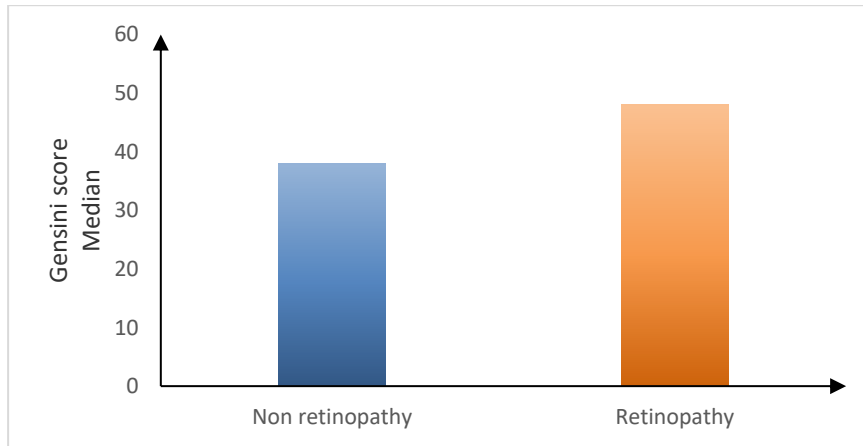
Fig.3. Relationship between retinopathy and Gensini score

Fig. 4 :Relationship between retinopathy and vessel score

Discussion

Cardiovascular diseases (CVS), including CAD represent major causes of morbidity and cardiovascular death in T2DM patients **(Che et al., 2018).**

Typically, diabetic patients have a number of cardiovascular disease risk factors, such as hyperglycemia, blood glucose fluctuations, central obesity, hyperlipidemia, and hypertension**(Che et**

al., 2018).The revised guidelines looked for a new assessmenttool to explicitly assess the risk for diabetic individuals despite the fact that diabetes was earlier considered to be a risk factor for CAD **(Bruemmer and Nissen, 2020).**The Framingham risk scores did not perform as desiredly in this population **(Shereef and Kandeel, 2019),** and existing CAD models for prediction in diabetic patients are inaccurate, therefore there is still a critical need to develop a Card prediction system for patients with diabetes **(Kaski et al., 2018).** A small percentage of Type 2 diabetes patients develop diabetic nephropathy (DN), which is indicated by severe nephropathy and albuminuria below 30 mg/day **(Che et al., 2018).** DN differs from the renal disease that diabetic people experience and causes a faster decline in renal function than nephropathy from other causes**(Dal Canto et al., 2019).** Additionally, diabetic retinopathy is a recognised micro-angiopathic consequence of diabetes mellitus that has a strong correlation to cardiovascular risk factors. Typically, retinal [fundus] pictures are used to detect it **(Van Dieren et al., 2010).** There are numerous qualitative indicators for evaluating micro-vascular pathology. However, modern computer-aided algorithms can help us identify microvascular damage, such as changes in retinal vascular diameter **(Ahmed et al., 2018).** Numerous investigations that examined individuals with and without retinopathy found that those with retinopathy had reduced coronary flow

reserve, lower coronary collateral scores, and more pronounced ischemic T-wave abnormalities on the ECG **(Naidoo, 2002).**The goal of the study was to evaluate how the severity of CAD in patients with T2DM as determined by coronary angiography related to the microvascular problems. The 70 instances of T2DM who were referred for coronary angiography due to suspected CAD were classified into 41 patients with nephropathy and 29 patients without nephropathy for this observational analysis. Then, 36 patients with retinopathy and 34 non-retinopathic individuals were separated into groups according to whether they had retinopathy or not. A thorough history, clinical examination, including a neurological sensory and motor assessment, and lab tests were performed on each patient.

In this study, the nephropathic group's duration of diabetes was considerably longer than that of the non-nephropathic group. According to these findings, 400 T2DM cases (41.5 percent of whom were men) were examined for nephropathy through the analysis of their registereies by **Hoque et al. in 2017**. Plasma glucose and HbA1c values were used to determine glycemic status. Patients with and without nephropathy had significantly different diabetes durations (7.95±2.447 vs 5.92±3.087, p<0.001). **Al-Rubeaan et al. (2014)** choose over 55000 T2DM patients aged 25 or older from the Saudi National Diabetes Registry (SNDR) and looked into the occurrence of diabetic

nephropathy in line with these findings. For the purposes of estimating prevalence and evaluating risk factors, cases with microalbuminuria, macroalbuminuria, and ESRD were categorised using the American Diabetes Association (ADA) criteria. It was found that diabetes duration, which ranged from 3.7% in length of >5 years to 21.8% in duration of 15 years, was a significant risk factor that had a significant impact on the prevalence of diabetic nephropathy.

Hemoglobin levels were considerably lower in the nephropathy group than in the non-nephropathy group in the current study (P=0.007). In comparison to the non-nephropathy group, the estimated Glomerular Filtration Rate was considerably lower in the nephropathy group. These findings are analogous to those of **Ravanan et al. (2006),** who collected clinical, biochemical, and laboratory information from 2,052 stable ambulatory patients who were a part of a single tertiary referral renal unit.After adjusting for other frequently associated factors that may be potential risk factors for anaemia in patients with renal impairment, the influence of diabetic renal disease on haemoglobin levels at all renal impairment degrees was examined by comparing patients with diabetic vs. non-diabetic kidney disease. When compared to patients with non-diabetic kidney disease, patients with diabetic kidney disease had lower haemoglobin levels (p<0.01).Additionally, **Matsushita et al. (2010)** included

baseline data on eGFR and urine albumin concentrations with standardised data for all-cause and cardiovascular mortality from studies with at least 1000 participants in a collaborative meta-analysis of general population cohorts. The analysis included about one million participants from seven trials with urine protein dipstick tests and over 105,000 people from 14 studies with urine albumin/creatinine ratio (ACR) measurements. They discovered that mortality and the prevalence of cardiovascular disease were both considerably increased by low eGFR.

In this study, the nephropathy group's HbA1c was considerably greater than that of the non-nephropathy group. **Chen et al. (2010)** assessed glycemic control in T2DM patients with CKD stages 3–4 in accordance with the results previously provided. A diagnostic test study was the study design that was used. T2DM patients were sourced from patients admitted to the Veterans General Hospital in Taipei, Taiwan, with normal kidney function (n=30) and abnormal kidney function (n=30). Self-monitoring of blood glucose levels was utilised as a reference test, with HbA1c and fructosamine serving as index tests.Six prepared blood glucose measures made up the measurements. In each month of the trial period, both groups' HbA1c levels considerably dropped, by 0.71% in patients with normal kidney function and 0.67% in patients with CKD, respectively. These results were in line with a research by

Kundu et al. (2013), which included 60 age- and sex-matched healthy adults as controls along with 30 T2DM patients with retinopathy and 30 T2DM patients without retinopathy. It was discovered that diabetic patients with retinopathy had higher mean values of FBS, PPBS, HbA1C, and urine total protein than diabetic patients without retinopathy and healthy controls.These findings corroborated those of **Hoque et al. (2017),** who noted that HbA1c category 8% (OR = 2.35) was found to be a significant risk factor for developing nephropathy and that increasing HbA1c categories above 7.0% sequentially showed higher prevalence compared with the lower category (15.8 vs 22.8 vs 30.7%). Furthermore, it has been noted that because to the wide variation in haemoglobin, nutritional status, and inflammation, the link between HbA1c and glucose is more complicated in more advanced stages of CKD. Furthermore, the predictive usefulness of HbA1c may be compromised by these comorbidities.

In the current study, the nephropathy group's Gensini score was considerably greater than that of the non-nephropathy group. **Kimet et al. (2013)** looked at the relationship between renal function and the severity of CAD, which is in line with our findings. The medical records of 1,192 patients who underwent elective coronary angiography were retrospectively reviewed. According to the degree of luminal narrowing and location(s) of obstruction in the affected major coronary artery, the Gensini score was used to assess the severity of

CAD.The Gensini score exhibited a positive link to rising stages of CKD in all patients (n=1,192), and it was highlighted that the differences between Non-CKD and CKD stage 3, CKD stage 3 and CKD stage 4, and CKD stage 4 and CKD stage 5 were significant (P< 0.05). As a result, both the prevalence and the severity of CAD are linked to impaired renal function. Additionally, **Wei et al. (2021)** enrolled 814 patients who were chosen for this trial and received a DES implant in a timely manner. Whether or not they had CKD determined how they were split into two groups.31.2% of their patients had CKD, while the remaining 68.8% were called the control group since they did not have CKD. Comparing the two groups' clinical physical traits, CAD lesions, and major adverse cardiac and cerebrovascular events (MACCE). They showed that the Gensini score was higher in the CKD group, with a median of 37 as opposed to just 27.5 in the control group. They came to the conclusion that CKD may play a significant role in predicting the prognosis of CAD.

In the current study, the retinopathy group's duration of DM was substantially longer than that of the non-retinopathy group. **Attia et al. (2020)** included 50 type 2 diabetes mellitus [DM] patients who were recommended for coronary angiography in accordance with Our findings. We performed a thorough medical history check, clinical examination, biochemical testing, electrocardiography (ECG),

echocardiography, coronary angiography, and fundus inspection. A group [A] of patients with diabetic retinopathy [DR] and a group [B] of patients without diabetic retinopathy were identified as having diabetic retinopathy. Coronary angiography was used to help treat coronary problems using two separate scores. They discovered that patients in group [A] had DM for a longer time than those in group [B].Similar research was conducted by **Cheung et al. (2007)** on 1,524 middle-aged T2DM patients who were free of prevalent CHD and stroke at baseline. Their findings showed that long-term diabetes was linked to a three-fold increased risk of fatal CAD and a two-fold increased risk of incident CHD events. **Um et al. (2016)** looked into the relationship between the severity of DR and the presence and severity of CHD among T2DM patients, and their findings concur with ours. They included 175 patients who had undergone dual-source computed tomography (DSCT) angiography within six months after their examination at the diabetic retinopathy clinic.They found that there were significant differences in the length of diabetes among individuals with no DR, no proliferative DR (NPDR), and proliferative DR (PDR) (8.6±5.9, 16.0±6.8, and 20.3±6.4, respectively) across these three DR grading groups (P<0.001). Furthermore, a cohort of 6,032 women and 5,612 men from a national network of hospital-based diabetes clinics were evaluated by **Avogaro et al. (2007)** and followed up

for 4 years. Foot ulcers, nephropathy, and retinopathy were all evaluated at the outset. A total of 29,000 person-years of first CHD events were examined, including myocardial infarction (MI), coronary artery bypass grafting (CABG), percutaneous transluminal coronary angioplasty (PTCA), and electrocardiogram-proven angina (ECG-PA).It was observed that both sexes shared the risk factor of diabetes duration for CHD. Furthermore, patients with microvascular problems had increased incidence rates for all outcomes.

In this study, the retinopathy group's HbA1c was considerably greater than that of the non-retinopathy group. Additionally, **Um et al. (2016)** found that no DR, no proliferative DR (NPDR), and proliferative DR (PDR) had significantly different mean HbA1c levels (7.2±0.9, 7.8±1.5, and 8.3±1.6, respectively) (P=0.003). Additionally, patients in the group with diabetic retinopathy had greater levels of HbA1c than patients in the group without diabetic retinopathy, according to **Attia et al. (2020).**Furthermore, **Yang et al(2019)**'s cross-sectional study in six community health service centres in Shanghai revealed that participants with DR had higher HbA1c values than those without DR (P <0.05), according to their findings. According to **Cheung et al. (2007),** HbA1c was linked to a two-fold increased risk of incident CHD events and a threefold increased risk of fatal CHD. This finding supported their findings (3.35 [1.40–8.01]).

Additionally, patients were gathered by **Kosiborod et al. (2018)** from both main and specialty healthcare settings. Assessments and standardizations for age and sex were done on the prevalence estimates of microvascular and macrovascular problems at baseline. Increased mean baseline HbA1c levels were found to be strongly correlated with microvascular.In agreement with our findings, **Pararajasingam et al. (2021)** performed a cross-sectional investigation on T2DM patients without a history of obstructive CAD, any clinical symptoms, or any objective signs of the condition. They showed that patients who had problems had higher HbA1c values than those who did not have complications.

In comparison to the non-retinopathy group, the retinopathy group's Gensini score was significantly greater. These findings were consistent with those of **Attia et al. (2020)**, who found that the DR group had significantly higher Vessels and Gensini scores than those without diabetic retinopathy [68.72±29.95vs 20.72±31.95]. Su et al.in their study, **Su et al. (2011)** recruiteda total of 344 T2DM subjects with chest discomfort and detection of CAD by coronary angiography in 252 patients is consistent with our findings. It was claimed that the Gensini score and haemoglobinA1c had a strong relationship (HbA1c). In the current investigation, the vascular score in the retinopathy group was considerably greater than in the non-retinopathy group.Similar results were reported by **Attia et al. (2019)** who found that the Vessels score DR group significantly outperformed the patients without diabetic retinopathy group [2.68±0.55 vs 0.64±0.95].

Conclusion

In patients with type 2 DM who underwent coronary angiography due to suspected (CAD), the nephropathic group had significantly higher creatinine, HbA1c, and Gensini score than the non-nephropathic group. Further,HbA1c and the duration of the DM . The retinopathy group had considerably higher Gensini scores and vascular scores than the non-retinopathy group. There was a substantial correlation between the severity of CAD as measured by coronary angiography and microvascular diabetes sequelae with retinopathy and nephropathy.

Limitations

The sample size of this study was relatively small and conducted at a single center. The serum creatinine levels measured before CA, and hence creatinine may be affected by drugs or acute clinical status. We did not collect data on the course of renal function and retinopathy in these patients, whether before or after angiography. Diabetic Neuropathy is not considered concerningthe severity of CAD because of the absence of a nerve conduction study.

Recommendations

Multi-centered prospective studies with larger sample sizes are needed in the future. The presence of DR and DN

and their severity with type-II DM can work as predictor tools for CAD severity. Physicians need to implement early prevention and treatment strategies for patients with DN and DR, concerning the possible development of CAD.

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