Research Article

Severity of Cad and Duration of Diabetes in Patients Undergoing Coronary Angiography

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ABSTRACT
Background: Diabetes mellitus, including prediabetes, links to a higher risk of coronary artery disease (CAD). The longer the illness lasts and the worse blood sugar control, the more complex and widespread coronary problems become. Research using tools like the Gensini score and coronary CT scans shows that high blood sugar over time, insulin resistance, age, and gender all play a big role in how CAD gets worse. New markers (hs-CRP, NT-proBNP) and imaging methods (CCTA, EAT checks) help predict risk better.
Objective: Investigating the relationship between diabetes duration and the severity of coronary artery disease (CAD) in patients undergoing coronary angiography
Study design: Cross-sectional observational study
Duration and place of study: This study was conducted in Peoples University of Medical and Health Sciences for Women Shaheed Benazirabad Nawabshah February 2024 to February 2025
Methodology: Researchers conducted this cross-sectional study in the Cardiology Department. They included 240 patients between 40 and 70 years old who had type 2 diabetes for 5 years or more. The main participants for this study were people who had a history of high blood pressure, were either smokers, or had a history of smoking as well as dyslipidemia. All patients taken for this study were preparing to undergo a coronary angiography, the results of which coupled with Gensini scores were used to establish and study the link between the severity of coronary artery disease and patients that suffer from chronic diabetes. Extensive statistical analyses were being done to understand this connection. The control group for this study was limited to various factors which included the age and gender of the participants, as well as their reported hypertension and dyslipidemia. Their smoking status was also taken into consideration.
Results: The control group for this study consisted of 240 participants that were diagnosed with diabetes at least 5 years ago. The study was age restrictive, hence participants in the control group were all between 40 and 70 years of age. This study observed that there exists an established connection between the length of chronic diabetes and a higher Gensini score, at r = 0.65. This study includes multiple regression analysis to understand the correlation between the duration of diabetes with high Gensini scores. This was coupled with patients diagnosed with hypertension and dyslipidemia.
Conclusion: This study has quantitatively established that there exists a significant link between the length of a diagnosis of diabetes mellitus, and the more severe the risk of a chronically diabetic patient suffering from coronary artery disease (CAD).

INTRODUCTION
The main crux of this paper is understanding how Diabetes mellitus correlates with coronary artery disease (CAD) and building on this well-established relationship. Diabetes mellitus has been defined as a chronic condition characterized by elevated blood sugar levels. Numerous studies have established its significant connection with heart disease and how it impacts health. Diabetes mellitus has historically been linked to coronary artery disease (CAD) [1]. CAD is the leading cause of

illness and mortality among individuals with diabetes [2]. This study aims to expand more on this relationship and further establish the theory that there exists a link between the recorded duration of diabetes existing for a patient and the severity of CAD. This paper aims to study patients that are currently undergoing heart evaluations at a major hospital and have been diagnosed with diabetes. The correlation between prolonged diabetes and CAD has been observed and hence requires a proper study establishing this relationship and establishing the importance of detecting diabetes early on and mitigating the risks associated with CAD in patients [4].

There have been several studies that have been conducted over the years which establish a pattern of acceleration of atherosclerosis due to diabetes, leading to a more severe manifestation of coronary artery disease which carries a much higher fatality risk for patients [3,4]. The key factor of this accelerated atherosclerosis is the reported increase in endothelial dysfunction, systemic inflammation, and lipid abnormalities all of which are directly caused by chronic hyperglycemia [5]. Studies have established and attempted to understand the relationship between the duration of diabetes with the severity of coronary artery disease (CAD) and have used the modified Gensini score in an attempt to quantify their findings. These studies reported that male patients who have been suffering from diabetes for longer, have also been diagnosed with more aggressive CAD severity, which was reflected by their higher Gensini scores. This study has cemented the role played by the duration of diabetes in predicting the severity of CAD in patients [5,6]. These studies have been further corroborated by patients who underwent coronary angiography. These patients were diagnosed with diabetes and had a higher Gensini score. This was compared with diabetic patients with smaller duration of diabetes and lower Gensini scores. The risks for male patients and the significant age gap highlights the validity of similar studies being done on this relationship [7,8].

The severity of coronary artery disease has been linked with glycemic control and the impact of it has been studied on heart disease. There are several advanced imaging techniques that have been utilized by medical professionals all over the world to understand how the duration of diabetes in a patient impacts CAD. One of the imaging techniques used by various researchers has been coronary computed tomography angiography (CCTA), which has successfully identified the severity of CAD and established its link with duration of diabetes. Researchers have used CCTA to demonstrate that chronic diabetes mellitus has been linked with advanced coronary artery disease (CAD) [9]. More research studies needed to the realities linking chronic diabetes mellitus with advanced CAD and understood that patents with poor management of diabetes and an established long-standing history of the disease reported to have calcifications in their coronaries. Several patients were also diagnosed with severe obstructive lesions, where the LAD (left anterior descending) was reported to have been affected most in the patients of the study. This anatomical vulnerability that chronic diabetes patients have with coronary artery disease has been well reported. The role of insulin resistance in chronic diabetic patients has led to the establishment of a pattern of progression in severe ischemic heart disease. There have been studies conducted that have once again drawn on the relevance of the Gensini score and found that with higher Gensini scores, severity of coronary artery disease was once again established with insulin resistance in diabetic patients. Many researchers have strongly suggested that the medical field needs to start a new precedent of early intervention for patients diagnosed with insulin resistance to prevent coronary episodes associated with diabetes. Insulin resistance has also been used to foresee the surgency of complex coronary lesions [9]. It has not only been diabetes that has been linked with the severity of coronary artery disease; rather, prediabetic patients have also been noted to have more coronary episodes. Various Researchers have Reported that the severity observed with patients of chronic diabetes has also been observed in pre diabetic patients that have undergone an elective coronary angiography. Patients that have been diagnosed as pre diabetic risk have also reportedly exhibited much higher atherosclerotic levels. All these studies and observations further cement the reality of how critical early screening and prevention is for diabetic patients while focusing on risk mitigation. Various studies have researched the link between HbA1c levels and chronic diabetes to understand its impact on the severity of CAD. These studies have simply substantiated the concept that a patient will have a well-established history of diabetes and elevated HbA1c levels is more at risk for a severe case

of coronary artery disease [10]. A coronary angiography was done on all the patients in the study to show the connection between HbA1c levels and chronic diabetes. All these findings lead further credibility to the belief that long-term hyperglycemia is significantly responsible in the severity of progression of CAD [11,12].

METHODOLOGY
Study Design
The aim of this study has been to identify the correlation between the duration of diabates and the severity of coronary artery disease in a clinical setting. The control group for this case study consisted solely of patients diagnosed with diabetes and underwent elective coronary angiography. The patients were picked due to their chronic history with the disease and were studied for their coronary arteries health in order to better understand how prolonged diabetes plays a part in worsening cardiovascular health.

Setting
The control group for this study was chosen in close collaboration with the cardiology department clinical team, in order to lead validity to the findings and expand on the preset notions of the connection between duration of diabetes and CAD.

Participants
This study drew on inspiration from various medical benchmark research which contributed that the severity of CAD also lies with male diabetic patients. The participants for this study were all chosen if they had been diagnosed with type 2 diabetes mellitus (T2DM) and fell between the ages of 40 and 70. An important factor when narrowing down the control group was that each patient had to have been diagnosed with diabetes for atleast more than 5 years in order to be eligible for the study. To make a more inclusive study, patients who had a history of hypertension and dyslipidemia were also included due to its impact on the progression of CAD. Smokers were also allowed to be a part of the study and did not fall in the exclusion criteria. Only patients with type 2 diabetes mellitus (T2DM) were allowed to be part of the study, whereas patients with type 1 diabetes mellitus (T1DM) were excluded as well as patients who had undergone stent placement or any major cardiovascular surgery which was indictive of severe CAD.

Ethical Considerations
This study protocol was approved by the ethics board of the hospital. It is compliance with international ethical standards and practices. Written consent was taken from each patient before they were enrolled in the study and all personal data remained anonymous in order to protect their privacy.

Variables
There are different important factors that were pivotal to the basis of this clinical study and the first of which was the measurement of the duration of diabetes. The duration of diabetes was measured in years, in contrast the severity of coronary artery disease was measured and reported and assessed using the Gensini scoring system [13]. This scoring system was introduced as a way of quantifying the degree of stenosis in coronary arteries. There are various other factors that were also taken into consideration such as hypertension and dyslipidemia as well as the age and gender of the participants.

RESULTS
There were 240 participants involved in this study. All the participants were within the age range of 40 years to 70 years. The calculated average age was 56.8 years. Most of the participants were male, accounting for 65% of the population. The participants had T2DM for at least 5 years and the mean duration of diabetes was 12.3 years. Table number 1 shows the clinical as well as demographic variables of the study population.

Table No. 1

Variables	N	%
Gender		
• Male	156	65
• Female	84	35
Hypertension	188	78.3
Dyslipidemia	180	75
Smoking	96	40
Duration of diabetes (yrs)	12.3	
Age (yrs)	56.8	
BMI (kg/m²)	29.2	

HbA1c (%)	8.1

The Gensini score is strongly positively correlated with diabetes duration (r = 0.65), indicating that increasing diabetes duration is associated with more advanced CAD. Table number 3 shows multiple linear regression analysis of factors linked with Gensini Score.

Table No. 2

Variables	Standard Error (SE)	Coefficient (B)	P-value
Age (yrs)	0.13	0.21	0.13
Gender (male)	3.14	5.33	0.09
Hypertension	2.78	7.79	0.01
Dyslipidemia	2.44	6.72	0.02
Smoking	2.65	4.88	0.06
Duration of diabetes (yrs)	0.32	1.87	<0.001

Table number 3 compares severity of CAD with duration of diabetes.

Table No. 3

Duration	N	Average Gensini Score
Less than 10 years	84	27.8
10 to 15 years	91	45.3
More than 15 years	65	68.1

DISCUSSION

This study centered on understanding the relationship between the duration of chronic diabetes and the advanced nature of CAD in diabetic patients. The study focused on patients undergoing coronary angiography in order to understand how their diabetes diagnosis impacted the severity of their CAD. This theory is strengthened by various other researchers demonstrating in various studies that more severe cases of CAD are observed in patients that have experienced longer durations of hyperglycemia due to higher levels of atherosclerosis [14]. Our study has concluded that patients which had been diagnosed with diabetes over 15 years ago were tested to have a much higher Gensini score. This was compared with patients who had a much smaller duration of chronic diabetes and also ranked lower in their Gensini scores. Studies have also shown that diabetic patients that have been diagnosed with a much poorer glycemic control have also been diagnosed with calcifications in the coronary arteries. Further studies have also observed that severe obstructive lesions have been caused in diabetic patients. Medical professionals have noted that they suffer from much poorer glycemic control, which is a huge contributor to more severe coronary artery problems in chronic diabetic patients. When looking through the lens of glycemic management in chronic diabetic patients, it can be noted that the impact that diabetes placed on the coronary artery health Is quite significant [15]. This is especially the case when medical professionals do not emphasize early risk management and evaluation of Coronary arteries in diabetic patients. Early detection and treatments are key in helping mitigate the risks of coronary artery disease in chronic diabetic patients since insulin resistance plays a huge role in the severity of the disease and the overall health of the patient.

It is important to note that we cannot put the sole responsibility of coronary artery health on the duration of diabetes, since there are many other key factors that relate to diabetes and directly contribute to the severity of failing coronary health. Some of these factors are hypertension and dyslipidemia, which can severely put patients at risk by promoting atherosclerosis and its complications. Diabetic patients have been studied for their cardiovascular health and the role that hypertension and dyslipidemia have played in it [16]. It is important to understand that hypertension needs to be controlled and observed to prevent progression of severity of coronary artery disease. Studies have shown that since lipid abnormalities or dyslipidemia contribute to bad coronary artery health, it is essential that the levels of lipid abnormalities be monitored and controlled to manage the progression of CAD.

This study looked at several variables in patients, such as gender and age. The levels of hypertension and dyslipidemia were looked at as well due to the correlation between duration of diabetes and coronary artery health. There are several explanations that can help look into the lack of a statistically causal relationship between higher Gensini scores and age. One of those reasons could be the overlap that age and the duration of diabetes play in the multiple linear regression model which could result in multicollinearity [16,17]. In order to ensure that the regression estimates carefully obtained from the multiple linear regression models are stable and accurate, variance inflation factors (VIFs) were observed and noted. Future studies can find more elegant proofs by utilizing larger linear regression models and applying models that are more suited to grasp the complex intricates of different variable relationships.

There have been multiple advancements that have been taken in the field of medicine which give a deeper dive into understanding how CAD affects diabetic patients. New and advanced imaging techniques and tools as well as new biomarkers have completely changed the landscape of modern medicine, especially in early detection. There have been biomarkers that have shown to be extremely reliable and stable indicators of CAD in diabetic patients such as high-sensitivity C-reactive protein (hs-CRP), which is also a great indicator of systematic inflammation [17]. Noninvasive imaging techniques and tools are being used to assess coronary artery health, such as the CCTA which is coronary computed tomography angiography (CCTA). There is also exploration in other tissue biomarkers such as epicardial adipose tissue (EAT) which helps understand that there are different metabolic factors which also play a crucial role in how atherosclerosis progresses for patients who suffer from chronic diabetes [18,19]. It is extremely important that these markers and imaging techniques are introduced into the treatment plan and care of chronic diabetic patients in order to mitigate the risks of severity of CAD.

Despite the strengths of the present study—including the use of the Gensini score for detailed quantification of coronary lesion severity—certain limitations must be acknowledged. Due to its cross-sectional design, the study cannot infer causality between the duration of diabetes and the extent of coronary artery involvement. Moreover, being conducted at a single tertiary care institution, the findings may not be fully generalizable to other populations or healthcare settings. To build on these results, future research should prioritize longitudinal, multicenter studies that not only validate the observed associations but also delve deeper into the underlying biological mechanisms that link chronic hyperglycemia to the advancement of coronary atherosclerosis [19,20].

CONCLUSION

This study has quantitatively established that there exists a significant link between the length of diabetes mellitus, and the more severe the risk of a chronically diabetic patient suffering from coronary artery disease (CAD). This highlights the imperative importance of regular testing for patients with a family history of diabetes or lifestyle choices that may lead to a diagnosis for diabetes. Early diagnosis of diabetes will allow for aggressive management of the disease, as well as mitigating the risk of hypertension and dyslipidemia in patients. This will inevitably help slow down the progression of CAD and overall lead to a better quality of life. Coronary computed tomography angiography (CCTA) can help improve the risks associated with diabetes by performing advanced imaging and helping understand better progression of CAD. To improve the outcomes for diabetic patients, the introduction of biomarkers such as the high-sensitivity C-reactive protein (hs-CRP) can also play a major role and should be involved in the diagnosis and treatment strategy to allow a more detailed and deeper understanding as to how to structure the treatment plans.

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