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Presence of coronary artery disease in adults with newly detected diabetes mellitus

Cheng-Chien Lai[1], Betty Chia-Chen Chang[2] and Lee-Ching Hwang[2,3*]

Abstract

Purpose We aimed to analyze the presence and extent of coronary artery disease in patients with newly detected diabetes mellitus.

Methods Clinical health examinations of asymptomatic community-dwelling adults between 2008 and 2018 at a medical center in Taiwan were reviewed. Coronary computed tomography angiography was performed in 444 participants, of which 338, 54, and 52 were categorized as 'without diabetes mellitus', 'newly detected diabetes mellitus', and 'known diabetes mellitus', respectively.

Results Prevalence of significant coronary artery disease (≥ 50% stenosis) was higher in participants with newly detected diabetes mellitus than in participants without diabetes mellitus (40.7% vs. 20.1%, $p < 0.0001$). Among those with coronary artery stenosis, the number of coronary vessels with significant obstruction (0.72 vs. 0.42, $p = 0.0147$) was also higher in participants with newly detected diabetes mellitus. Using multiple logistic regression analysis, new detection of diabetes mellitus was identified as an independent risk factor for significant coronary artery disease (odds ratio: 2.153, 95% confidence interval: 1.112–4.166).

Conclusion Asymptomatic patients with newly detected diabetes mellitus had higher prevalence and greater extent of coronary artery disease than those without diabetes mellitus. More attention should thus be paid to the assessment of coronary artery disease in patients with newly detected diabetes mellitus.

Keywords Coronary artery disease, Coronary computed tomography angiography, Newly detected diabetes mellitus

Introduction

Due to lifestyle changes and ageing society, the prevalence of diabetes mellitus (DM) is increasing worldwide [1]. The International Diabetes Federation estimated that 537 million adults were living with DM in 2021, and the number would rise to 783 million by 2045, leading to enormous global health burden and challenges in clinical practice [2, 3].

For patients with DM, not only glycemic control, but also prevention of chronic complications is an important issue [4–7]. Standard care for preventing complications in type 2 DM patients includes comprehensive eye examinations by ophthalmologists to evaluate diabetic retinopathy, sensation testing for neuropathy, and urine tests

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for diabetic kidney disease [5, 6]. Screening for other risk factors of macrovascular complications, including hypertension, obesity, and dyslipidemia, is also strongly suggested [4, 7]. Many studies have been conducted to estimate the prevalence of these chronic complications in patients with newly diagnosed DM [8–11].

Of all the complications of DM, atherosclerotic cardiovascular disease (ASCVD) is the leading cause of mortality and morbidity [4, 12, 13]. For risk stratification, coronary computed tomography angiography (CCTA) has been proven to predict major adverse cardiac events more accurately than traditional risk factors and coronary artery calcium scores [14–16]. A previous study showed that, in 44 asymptomatic patients with newly diagnosed type 2 DM, 29 patients (66%) had coronary artery calcification detected by CCTA in a Caucasian population, implying a high prevalence of coronary artery disease (CAD) in this group of patients [17].

However, the use of CCTA for screening of cardiovascular disease in asymptomatic patients with DM remains controversial [18]. Current guidelines do not recommend routine screening for CAD in asymptomatic patients with DM due to a lack of evidence for improved cardiovascular outcomes [4]. Randomized controlled trials have shown no significant difference in the risk of fatal cardiovascular events or unstable angina between patients who underwent CCTA and those who followed standard care [19]. The low frequency of cardiovascular events and the lack of routine revascularization based on CCTA results may explain these findings [18].

While the prevalence of microvascular complications in patients with newly detected DM has been well studied, data on macrovascular complications in this specific population remains sparse. Given this gap, our study aims to estimate the prevalence and extent of CAD in asymptomatic patients at the time of DM diagnosis, contributing to the ongoing discussion on the value of early detection of CAD in newly diagnosed DM patients.

Methods

Study population and data acquirement

Clinical health examinations of community-dwelling adults aged 30 to 75 years between 2008 and 2018 at a medical center in Taiwan were reviewed. The age range of 30 to 75 years was chosen based on the increased risk of developing type 2 DM within this age group, as shown in previous epidemiology studies [20]. Participants over 75 years old were excluded to reduce the influence of advanced age and other age-related comorbidities that could confound the study results.

During the health examination, current symptoms, past medical history, and chronic medications were recorded. Physical examinations were performed, and basic hematological and biochemical profiles were obtained. Advanced examinations, including CCTA, were performed at the request of the participants. The decision to undergo CCTA was based on individual preference, which may have been influenced by the participants' level of health literacy and socioeconomic status. Notably, there were some missing data on chronic medications, but adjustments were made using laboratory data to account for the potential influence of these medications.

We enrolled participants who had complete data of CCTA, fasting plasma glucose, postprandial glucose, and hemoglobin A1c. Participants were excluded from the study if they were older than 75 years or had a known history or symptoms of CAD, including chest discomfort or unexplained dyspnea [4]. This study was approved by the Ethics Committee of Mackay Memorial Hospital (Institutional review board number: 18MMHIS137).

Participants were categorized into three groups for further analysis: known DM, newly detected DM, and control group without DM. In the 'known DM' category, participants either reported a past history of DM or were under antidiabetic medication. For the 'newly detected DM' category, the participants did not have past history of DM nor use of antidiabetic medication. New detection of DM was defined if any of the following was present [21–23]: (1) fasting plasma glucose ≥ 7.0 mmol/L (126 mg/dL), (2) 2-hour postprandial plasma glucose ≥ 11.1 mmol/L (200 mg/dL), or (3) hemoglobin A1c ≥ 6.5% (47.5 mmol/mol). Participants were categorized as 'control group without DM' if none of these criteria were met.

A total of 499 participants underwent CCTA as part of their clinical health examination. After excluding 55 participants based on the criteria mentioned above, 444 participants were included in the study, of which 338, 54, and 52 were categorized as 'control group without DM', 'newly detected DM', and 'known DM', respectively. The flowchart of participant inclusion and categorization was presented in Fig. 1.

Interpretation of coronary computed tomography angiography

The presence and extent of CAD were evaluated using CCTA (SOMATOM Definition Flash, Siemens Healthcare), performed on the same day as the health examination. Certified radiologists interpreted the images and provided formal reports. For each patient, the degrees of stenosis in the left main coronary artery, left anterior descending artery, left circumflex artery, and right coronary artery were assessed. Significant CAD was defined as having significant obstruction (≥ 50% stenosis) in any coronary vessels [24, 25]. Participants with one-, two-, or three-vessel disease were categorized according to the number of arteries with significant stenosis. Additionally, the severity of CAD was defined using the Coronary

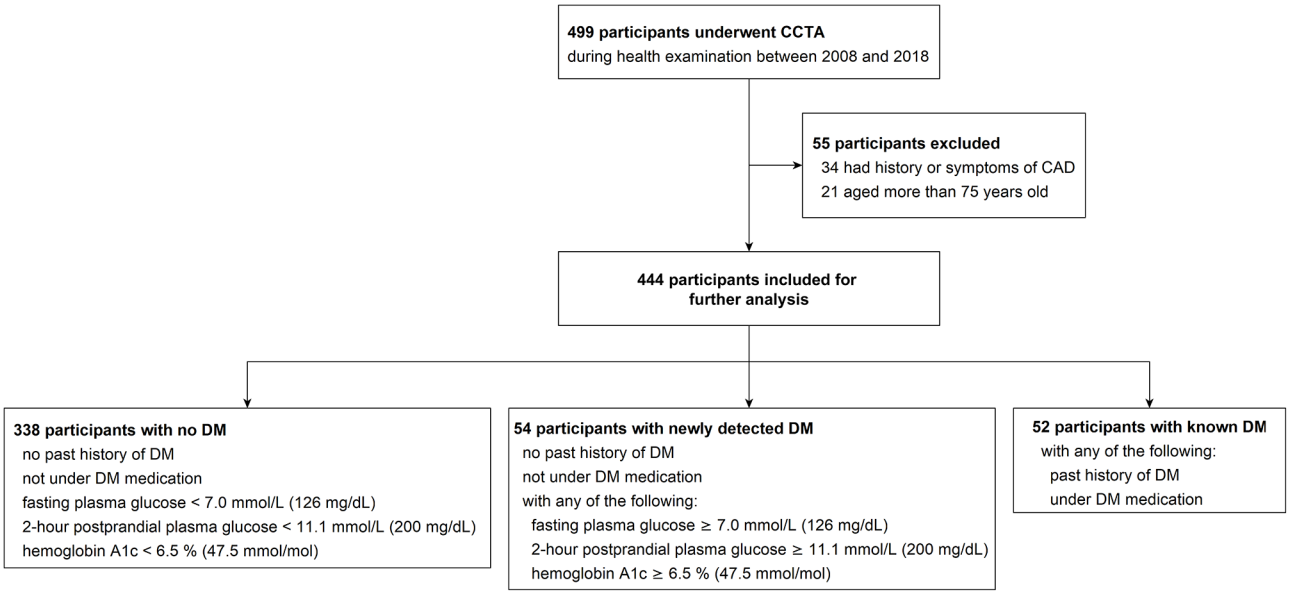

Fig. 1 Flowchart of participant inclusion and categorization. CCTA: Coronary computed tomography angiography; CAD: Coronary artery disease; DM: diabetes mellitus

Artery Disease-Reporting and Data System (CAD-RADS) score [25]. The score ranged from 0 to 5, with a higher score indicating a more severe disease. Grade 0 indicated absence of CAD; grade 1 indicated minimal non-obstructive CAD with 1–24% stenosis; grade 2 indicated mild non-obstructive CAD with 25–49% stenosis; grade 3 indicated moderate CAD with 50–69% stenosis; grade 4 A indicated severe CAD with 70–99% stenosis in one or two vessels; grade 4B indicated severe CAD with ≥ 50% stenosis in left main coronary artery or 70–99% stenosis in three vessels; grade 5 indicated presence of total coronary occlusion.

Statistical analysis

Statistical analyses were carried out using the SAS software, version 9.4. Clinical characteristics were presented as means for continuous variables and frequencies for categorical variables. Independent T-test, analysis of variance (ANOVA), and chi-squared test were used to compare the demographic characteristics and results of CCTA among different groups of participants. Adjusted odds ratios were calculated using multiple logistic regression analysis to determine the risk factors associated with significant CAD. Statistical significance was considered with a p-value < 0.05.

Results

Clinical characteristics

Of the 444 participants included in the study, 329 (74.1%) were men and 115 (25.9%) were women, with an average age of 56.3 ± 9.2 years. Numbers of participants meeting criteria of 'control group without DM', 'newly detected DM', and 'known DM' were 338, 54, and 52, respectively. The distribution of gender was similar among the groups. However, significant differences were observed in age, prevalence of hypertension, smoking status, body mass index, waist circumference, and lipid profiles. Specifically, participants without DM were younger, less likely to smoke, and had smaller waist circumferences, lower plasma glucose levels, and lower hemoglobin A1c levels. Participants with newly detected DM had a higher body mass index and triglyceride levels, while those with known DM had a higher prevalence of hypertension and lower levels of total cholesterol and low-density lipoprotein, reflecting more intensive medical management and use of lipid-lowering medications. Detailed demographic information was presented in Table 1.

Assessment of coronary artery disease

The prevalence of significant CAD was significantly higher in participants with newly detected DM than in those without DM, (40.7% vs. 20.1%, $p < 0.0001$). The CAD-RADS score also indicated greater CAD severity in the newly detected DM group, with 13.0% of participants having CAD-RADS scores of 4 or higher, suggesting the need for aggressive risk factor modification and potential consideration for invasive coronary angiography [24]. The prevalence of multivessel CAD was 14.8% in participants with newly detected DM, also indicating more severe disease and poorer prognosis [26]. Among those with the presence of coronary artery stenosis, the number of coronary vessels with significant obstruction was significantly higher in participants with newly detected DM (0.72 vs. 0.42, $p = 0.0147$). These findings underscore

Table 1 Clinical characteristics of the study population

	Non-DM (*n* = 338)	Newly detected DM (*n* = 54)	Known DM (*n* = 52)	*p*-value (Non-DM vs. Newly detected DM)	*p*-value (Non-DM vs. Known DM)	*p*-value (Newly detected DM vs. Known DM)	*p*-value (3 Groups)
Age (years)	55.2 ± 9.3	58.6 ± 7.5	60.9 ± 7.7	0.0112	< 0.0001	0.1098	< 0.0001
Male (n, %)	244 (72.2)	42 (77.8)	43 (82.7)	0.3906	0.1097	0.5257	0.2205
Hypertension (n, %)	128 (37.9)	18 (33.3)	33 (63.5)	0.522	< 0.0001	0.0019	0.0012
Chronic kidney disease (n, %)	16 (4.7)	2 (3.7)	6 (11.5)	0.7299	0.0736	0.1269	0.1092
Ever-smoker (n, %)	92 (27.2)	22 (40.7)	27 (51.9)	0.0422	0.0003	0.2483	0.0006
Ever-alcohol user (n, %)	84 (25.2)	19 (35.2)	17 (34.0)	0.1213	0.185	0.899	0.1661
Body mass index (kg/m^2)	25.6 ± 3.7	27.4 ± 4.3	25.8 ± 3.8	0.0009	0.6876	0.0411	0.0038
Waist circumference (cm)	88.0 ± 9.8	93.5 ± 11.4	91.4 ± 10.2	0.0002	0.0234	0.3174	0.0003
Large waist circumference [a] (n, %)	173 (51.2)	35 (64.8)	31 (59.6)	0.0624	0.2571	0.5809	0.118
Systolic blood pressure (mmHg)	126.8 ± 17.6	128.9 ± 16.2	131.7 ± 14.1	0.4077	0.0595	0.3585	0.1384
Diastolic blood pressure (mmHg)	78.9 ± 10.9	78.7 ± 10.8	79.7 ± 11.2	0.8987	0.6219	0.6374	0.8682
Fasting plasma glucose (mmol/L)	5.5 ± 0.5	7.3 ± 1.9	7.7 ± 2.1	< 0.0001	< 0.0001	0.3071	< 0.0001
Hemoglobin A1c (%)	5.6 ± 0.3	7.0 ± 1.1	7.2 ± 1.1	< 0.0001	< 0.0001	0.429	< 0.0001
Total cholesterol (mmol/L)	5.2 ± 1.0	5.4 ± 1.1	4.5 ± 1.0	0.3487	< 0.0001	0.0001	< 0.0001
Triglyceride (mmol/L)	1.7 ± 1.1	2.3 ± 1.6	1.8 ± 1.0	0.0011	0.4829	0.0751	0.0038
High level of triglyceride [b] (n, %)	117 (34.6)	29 (53.7)	21 (40.4)	0.0071	0.418	0.1697	0.0244
High-density lipoprotein (mmol/L)	1.3 ± 0.4	1.2 ± 0.4	1.1 ± 0.3	0.0778	0.002	0.2336	0.0029
Low level of high-density lipoprotein [c] (n, %)	103 (30.5)	23 (42.6)	24 (46.2)	0.0766	0.0247	0.7122	0.0289
Low-density lipoprotein (mmol/L)	3.3 ± 0.9	3.5 ± 1.0	2.8 ± 0.9	0.1955	0.0002	0.0002	0.0002
High level of low-density lipoprotein [d] (n, %)	167 (49.4)	28 (51.9)	14 (26.9)	0.7388	0.0025	0.0087	0.0078
Estimated glomerular filtration rate (mL/min)	86.4 ± 18.5	90.4 ± 16.7	84.0 ± 21.6	0.1379	0.4063	0.0934	0.2014

DM: diabetes mellitus. Values are mean ± standard deviation for continuous variables, and n (%) for binary variables. [a] Large waist circumference was defined as waist circumference ≥ 90 cm in men and ≥ 80 cm in women. [b] High level of triglyceride was defined as triglyceride ≥ 1.7 mmol/L (150 mg/dL). [c] Low level of high-density lipoprotein was defined as high-density lipoprotein < 1.03 mmol/L (40 mg/dL) in men and < 1.29 mmol/L (50 mg/dL) in women. [d] High level of low-density lipoprotein was defined as low-density lipoprotein ≥ 3.36 mmol/L (130 mg/dL)

the substantial cardiovascular risk present even at the time of DM diagnosis.

In participants with known DM, approximately half (51.9%) had significant CAD, 9.6% had CAD-RADS scores 4 or higher, and 23.1% presented with multivessel disease. In participants with known DM and coronary artery stenosis, both the number of coronary vessels with significant obstruction (0.88 vs. 0.42, $p = 0.0003$) and the maximal degree of stenosis (53.1% vs. 47.3%, $p = 0.0284$) were significantly higher compared to participants without DM. The prevalence of significant CAD and the number of obstructed coronary vessels among the three groups were shown in Figs. 2 and 3, respectively. Detailed results of the CCTA assessments were summarized in Table 2.

Risk factors for significant coronary artery disease

Multiple logistic regression analysis revealed that male gender (odds ratio [OR]: 3.178, 95% confidence interval [CI]: 1.636–6.173), age (OR: 1.082, 95% CI: 1.048–1.117), and high level of low-density lipoprotein (OR: 1.676, 95% CI: 1.033–2.722) were independent predictors of significant CAD. Participants with newly detected DM (OR: 2.153, 95% CI: 1.112–4.166) and known DM (OR: 3.129, 95% CI: 1.589–6.159) were also at higher risk of significant CAD than those without DM. The results of multiple logistic regression analysis were shown in Table 3.

Discussion

In this study, we found that the prevalence of significant CAD detected by CCTA was significantly higher among asymptomatic adults with newly detected DM than those without DM. Participants with newly detected DM and coronary artery stenosis also had a higher number of coronary vessels with significant obstruction, indicating a greater extent of CAD. Independent risk factors for CAD included age, gender, elevated low-density lipoprotein levels, and the presence of DM, aligning with established ASCVD risk factors [27].

Type 2 DM significantly increases ASCVD risk through mechanisms including endothelial dysfunction, oxidative stress, and chronic inflammation [28]. Diabetic dyslipidemia, characterized by elevated triglycerides, small dense low-density lipoprotein, and reduced high-density lipoprotein levels, accelerates atherosclerosis. Insulin resistance further impairs lipid metabolism, contributing to plaque buildup in arteries. Endothelial dysfunction, driven by the overproduction of advanced glycation end-products and reactive oxygen species, reduces nitric

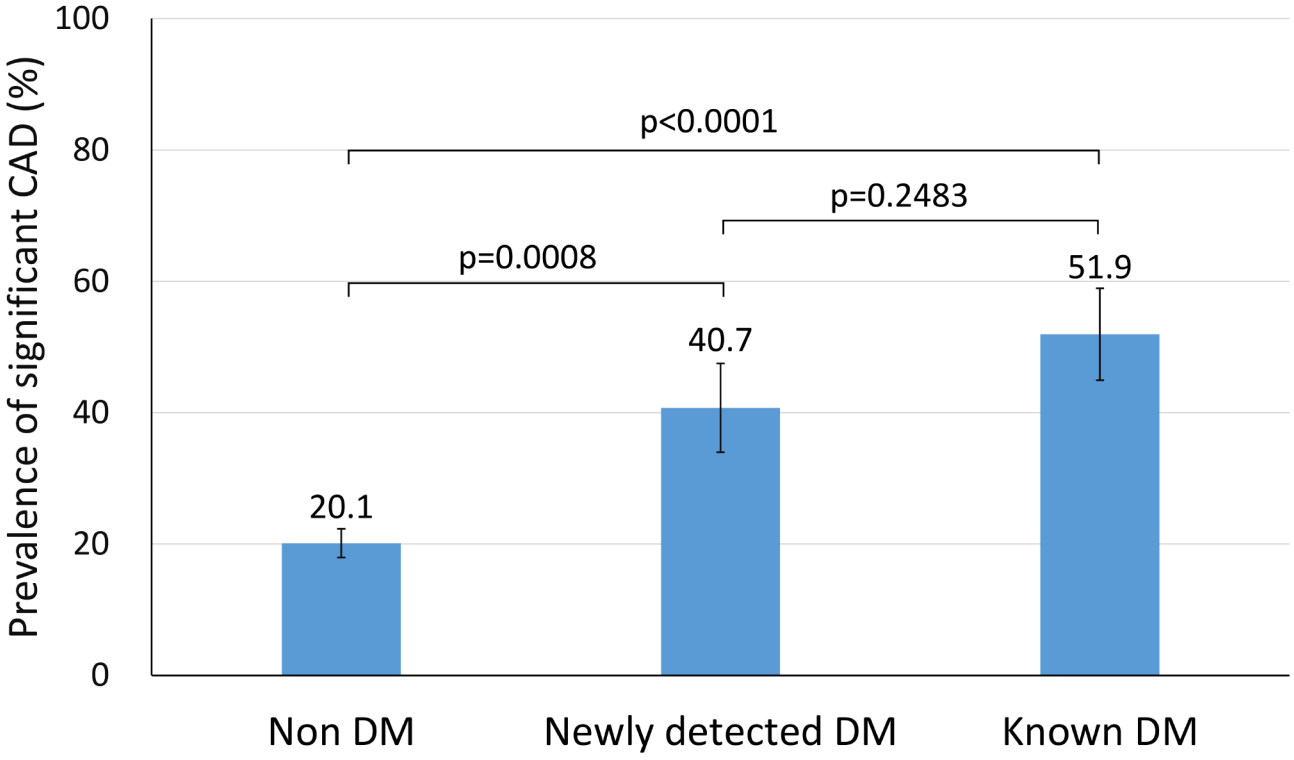

Fig. 2 Prevalence of significant coronary artery disease among asymptomatic participants without diabetes mellitus, with newly detected diabetes mellitus, and with known diabetes mellitus. The standard error of the mean was shown in error bars. CAD: Coronary artery disease; DM: diabetes mellitus

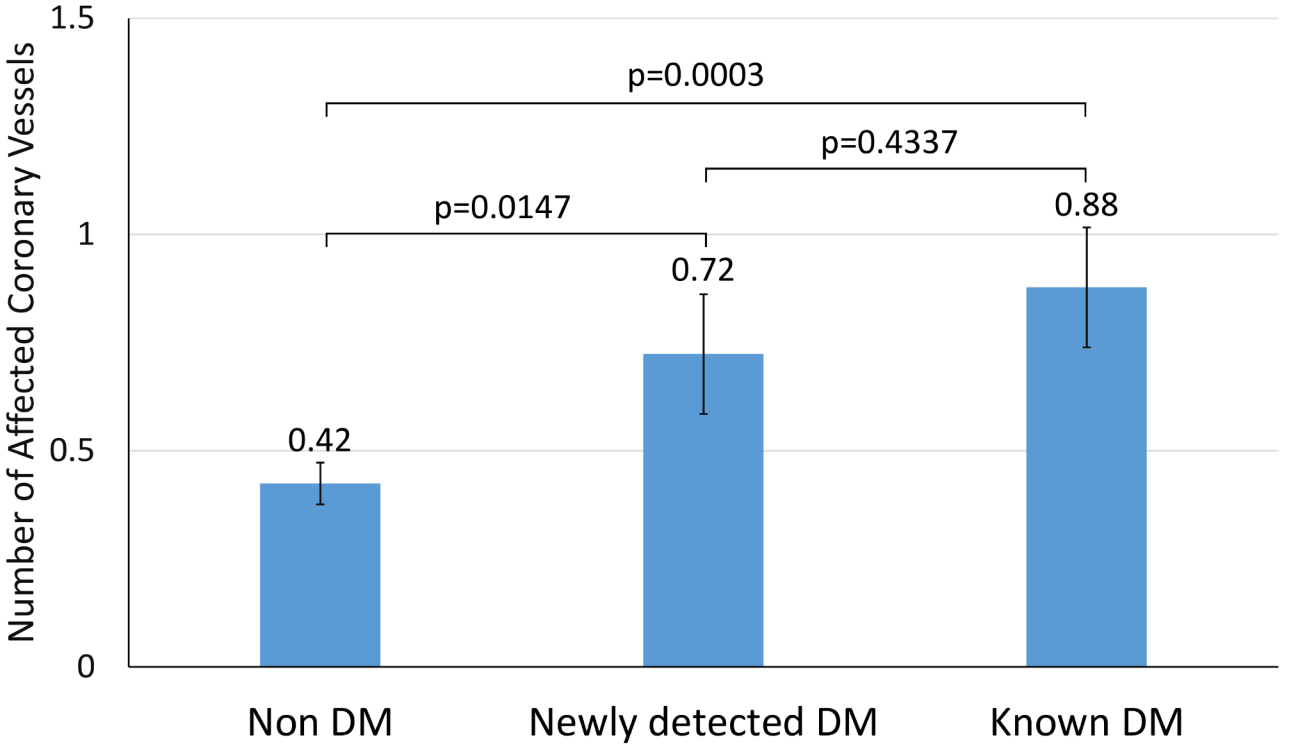

Fig. 3 Number of coronary vessels with significant obstruction in participants with coronary artery stenosis. The standard error of the mean was shown in error bars. DM: diabetes mellitus

Table 2 Assessment of coronary artery disease with coronary computed tomography angiography

	Non-DM (*n* = 338)	Newly detected DM (*n* = 54)	Known DM (*n* = 52)	*p*-value (Non-DM vs. Newly detected DM)	*p*-value (Non-DM vs. Known DM)	*p*-value (Newly detected DM vs. Known DM)	*p*-value (3 Groups)
Significant CAD [a] (n, %)	68 (20.1)	22 (40.7)	27 (51.9)	0.0008	< 0.0001	0.2483	< 0.0001
CAD-RADS score (n, %)							< 0.0001
0	121 (35.8)	7 (13.0)	3 (5.8)				
1 + 2	149 (44.1)	25 (46.3)	22 (42.3)				
3	41 (12.1)	15 (27.8)	22 (42.3)				
4 A + 4B + 5	27 (8.0)	7 (13.0)	5 (9.6)				
Number of coronary vessels with significant obstruction[a] (n, %)							< 0.0001
0 vessel	270 (79.9)	32 (59.3)	25 (48.1)				
1 vessel	48 (14.2)	14 (25.9)	15 (28.9)				
2 vessels	16 (4.7)	4 (7.4)	8 (15.4)				
3 vessels	4 (1.2)	4 (7.4)	4 (7.7)				
Mean affected coronary vessels[a]	0.27 ± 0.60	0.63 ± 0.92	0.83 ± 0.97	0.0002	< 0.0001	0.2829	< 0.0001
Mean affected coronary vessels[a] in participants with coronary artery stenosis[b]	0.42 ± 0.71	0.72 ± 0.95	0.88 ± 0.97	0.0147	0.0003	0.4337	0.0004
Degree of maximal coronary stenosis (%)	30.4 ± 26.5	42.3 ± 24.3	50.1 ± 19.6	0.002	< 0.0001	0.0732	< 0.0001
Degree of maximal coronary stenosis (%) in participants with coronary artery stenosis[b]	47.3 ± 17.1	48.6 ± 19.2	53.1 ± 15.5	0.6405	0.0284	0.2043	0.0992

DM: diabetes mellitus; CAD: coronary artery disease; CAD-RADS score: Coronary Artery Disease-Reporting and Data System score; Values are mean ± standard deviation for continuous variables, and n (%) for binary variables. [a]Significant CAD and significant obstruction were defined as the presence of one or more obstructive (≥ 50%) lesions. [b]Participants with coronary artery stenosis were defined as having CAD with presence of any degree (≥ 1%) of stenosis

Table 3 Multiple logistic regression analysis of significant coronary artery disease

	Odds ratio	95% Confidence interval
Male gender	3.178	1.636–6.173
Age (per year)	1.082	1.048–1.117
Newly detected DM	2.153	1.112–4.166
Known DM	3.129	1.589–6.159
Hypertension	1.020	0.623–1.671
Ever-smoker	1.043	0.597–1.823
Body mass index	0.979	0.912–1.050
High level of triglyceride[a]	1.448	0.865–2.423
Low level of high-density lipoprotein[b]	1.426	0.847–2.401
High level of low-density lipoprotein[c]	1.676	1.033–2.722

DM: diabetes mellitus. [a] High level of triglyceride was defined as triglyceride ≥ 1.7 mmol/L (150 mg/dL). [b] Low level of high-density lipoprotein was defined as high-density lipoprotein < 1.03 mmol/L (40 mg/dL) in men and < 1.29 mmol/L (50 mg/dL) in women. [c] High level of low-density lipoprotein was defined as low-density lipoprotein ≥ 3.36 mmol/L (130 mg/dL)

oxide and increases vascular inflammation. Additionally, a deficiency in protective adipokines exacerbates vascular stiffness and plaque vulnerability. This combination of metabolic and vascular disturbances explains the increased ASCVD risk in DM patients, even though the extent to which DM is considered a 'major CAD risk factor' or a 'CAD risk equivalent' remains debated [29, 30].

The delay between the onset of hyperglycemia and the diagnosis of DM is common and is estimated to be 4–6 years on average [31]. During this period, both microvascular and macrovascular complications can develop and progress before DM is formally diagnosed. While microvascular complications at DM diagnosis have been well-documented, such as diabetic nephropathy in 18.2% and retinopathy in 25.5%[8], the epidemiology of CAD at DM diagnosis is much less frequently described. A prior study with 44 asymptomatic patients diagnosed with DM within 1 year found higher coronary artery calcification rates compared to matched controls (66% vs. 48%, $p < 0.05$), but no significant difference in the prevalence of coronary obstruction (≥ 70% stenosis) (9.1% vs. 6.8%, $p = 0.50$) with the use of CCTA [17]. In our study, with a larger sample size, we found a significantly higher prevalence of significant CAD (≥ 50% stenosis) in participants with newly detected DM compared to those without DM (40.7% vs. 20.1%, $p < 0.0001$), suggesting that CAD, similar to microvascular complications, may develop before DM is detected.

For patients with established DM, studies have shown a correlation between the duration of hyperglycemia and increased risks of CAD. Gurudevan et al. found a higher prevalence of obstructive CAD (≥ 60% stenosis) in participants with impaired fasting glucose compared to those with normal fasting glucose (29.5% vs. 13.3%, $p = 0.02$) [32]. Kim et al. demonstrated that a longer duration of DM was associated with a greater risk of significant CAD (≥ 50% stenosis) (49.1%, 29.6%, and 28.3% in patients with DM duration ≥ 10 years, 5–10 years, and < 5 years, respectively, $p < 0.001$) [33]. These findings imply that,

beyond the initial elevated CAD risk at DM diagnosis, the risk continues to increase with time.

The scarcity of epidemiology data on CAD at the time of DM diagnosis may be due to the lack of observed benefit in previous clinical trials and the current guidelines that do not recommend routine screening for CAD in asymptomatic DM patients [4, 19]. CCTA provides detailed information on plague distribution and vascular stenosis and has been shown to improve risk stratification for CAD [14, 15], even in asymptomatic patients with DM [34, 35]. However, its routine use for screening CAD in asymptomatic patients is not supported by current evidence [19]. Furthermore, the risks associated with CCTA, including radiation exposure and the use of contrast medium [36], make it less favorable as a universal screening tool. Alternatively, other methods, such as common carotid artery intima-media thickness (CIMT), have been found to be increased in patients with newly diagnosed type 2 DM [37], correlating with the presence and severity of CAD in asymptomatic DM patients [38]. Similarly, the reactive hyperemia index (RHI) [39] and ankle-brachial index (ABI) [40] have demonstrated predictive value for CAD in patients with type 2 DM, offering more affordable and accessible options for assessing cardiovascular risk in primary care settings. Additionally, risk stratification tools including the ASCVD risk score [27], which rely on readily available clinical data, remain valuable for guiding prevention strategies at the population level.

As ASCVD remains the leading cause of morbidity and mortality in DM [12, 13], its importance cannot be emphasized enough by both patients and clinicians. The finding of a 40.7% prevalence of significant CAD in participants with newly detected DM highlights the need for continued research into screening and managing CAD in this population, especially as the detection techniques and management strategies continue to evolve. Also, this study is the first to report data on CAD prevalence in newly detected DM in the Asian population, providing a foundation of future population-based guideline development.

Several limitations should be noted. First, data were collected from a single medical center, and CCTA was performed based on participants' preferences, which may have introduced selection bias related to self-concern and socioeconomic status. However, the age and gender distribution of newly detected DM participants aligns with nationwide data in Taiwan [41]. Second, information on plaque composition and burden was missing in some of the CCTA reports, limiting further analysis of plaque characteristics. Nevertheless, the data on coronary stenosis were complete, allowing significant findings to be derived. Similarly, information about chronic medication was incomplete, while the biological effect of some of the medication was analyzed, such as lipid profiles for lipid-lowering medications. Other potential confounders, including lifestyle and diet, were not assessed. Third, although participants labeled as newly detected DM met at least one diagnostic criterion, more information is needed to confirm the diagnosis. As a cross-sectional study, follow-up data was unavailable. Finally, this study focused on CCTA for its ability to directly visualize coronary artery stenosis. However, it is important to note that alternative methods, including CIMT, RHI, ABI, and cardiovascular risk scores, may be more practical for large-scale screening due to their cost-effectiveness and ease of implementation. Future studies should compare these methods directly to assess their relative strengths in detecting CAD in newly diagnosed DM patients. Further investigation is also needed to elucidate the progression of CAD in patients with DM.

Conclusion

The prevalence and extent of CAD in asymptomatic patients with newly detected DM were significantly higher than in participants without DM. New detection of DM was an independent risk factor for significant CAD after adjusting for age, gender, hypertension, smoking, body mass index, and dyslipidemia. With a prevalence of significant CAD as high as 40.7%, greater attention should be given to assessing CAD in patients with newly detected DM. As detection techniques and management strategies for CAD continue to evolve, this study provides a foundation for future research into screening strategies, emphasizing the need for larger, diverse cohorts to evaluate the role of CCTA and alternative methods in improving cardiovascular outcomes in these patients.

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Author contributions

Conceptualization, C.-C.L. and L.-C.H.; methodology, C.-C.L. and L.-C.H.; software, C.-C.L. and L.-C.H.; Validation, C.-C.L., B.C.-C.C., and L.-C.H.; formal analysis, C.-C.L. and L.-C.H.; investigation, C.-C.L. and L.-C.H.; resources, B.C.-C.C. and L.-C.H.; data curation, C.-C.L. and L.-C.H.; writing - original draft preparation, C.-C.L.; writing - review and editing, B.C.-C.C. and L.-C.H.; visualization, C.-C.L.; supervision, L.-C.H.; project administration, L.-C.H. All authors have read and agreed to the published version of the manuscript.

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Data availability

The data that support the findings of this study are available from the corresponding author upon reasonable request.

Declarations

Ethics approval and consent to participate

The study was conducted in adherence to the principles stated in the Declaration of Helsinki. The use of clinical health examination data was approved by Mackey Ethics Committee of Mackay Memorial Hospital (Institutional review board number: 18MMHIS137). Informed consent was waived by the aforementioned ethics committee, Mackey Ethics Committee of Mackay Memorial Hospital (Institutional review board number: 18MMHIS137), because the data used in the study was deidentified.

Consent for publication

Not applicable.

Competing interests

The authors declare no competing interests.

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