INCIDENCE AND RISK FACTORS OF DIABETIC RETINOPATHY AMONG PATIENTS WITH TYPE 2 DIABETES IN A COMMUNITY HOSPITAL, CENTRAL THAILAND

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Abstract

Background: Diabetic retinopathy (DR) is one of the ocular complications among patients with type 2 diabetes (T2D) in both developed and developing countries. At present, epidemiological data of DR and the risk factors among patients with T2D especially in Thai community hospitals have been limited.

Methods: A retrospective cohort study was conducted between January 1, 2013 and December 31, 2020 to determine the incidence and risk factors of DR among patients with T2D visiting Tha Wung Hospital, Lop Buri Province, central Thailand. DR was determined according to the International Classification of Diseases, Tenth Revision codes in E113 presented in medical records. Multivariate Cox regression analysis was performed to obtain the adjusted hazard ratios (HR) and 95% confidence interval (CI) of the factors related to DR.

Results: A total of 2007 patients with T2D were enrolled in the present study. During the study period, participants (5.3%) had a diagnosis of DR; the incidence rate was 0.9 per 100 person-years (95% CI; 0.7-1.1). The independent risk factors for DR included HbA1c ≥8% (adjusted hazard ratio (AHR) = 4.7, 95% CI; 2.5-8.7), urine albumin 3+ (AHR = 2.4, 95% CI; 1.1-5.3), urine albumin 4+ (AHR = 20.3, 95% CI; 2.7-150.9), and a longer distance between residential area (AHR= 1.3, 95% CI; 1.2-1.4).

Conclusion: Patients with T2D should be encouraged to reach their glycemic control indicated by HbA1c level. Additionally, effective health interventions should be conducted to contribute appropriate access to diabetic care for patients residing in remote areas.

Keywords: Diabetic retinopathy, Community hospital, Thailand, Incidence, Risk factors

Introduction

Diabetic retinopathy (DR) not only affects health and quality of life, but also presents a costly burden to patients with type 2 diabetes (T2D), their family members, communities and public health systems. Estimated DR prevalence was 18.45 to 36.2%, globally; additionally, DR prevalence has increased over the past decade.[1-4] Furthermore, the annual incidence of DR among patients with T2D were 4.0%, 5.0%, 10.4% and 12.7% in Europe, Sweden, the US, and China, respectively.[5-8] Related studies have reported that essential risk factors for DR included duration of T2D diagnosis, history of insulin used[1,2,4], hemoglobin A1C level[1,4,9], high blood pressure[4,9], pulse pressure[10,11] and lengthy distance from home to obtain care.[12] In many countries such as Germany, the cost of DR increased with the severity of DR accounting for 1.5% of the cost to the public health system in 2002.[13] In the US, people with financial burden were poorly followed up for treatment.[14] Moreover, a rapidly growing rate of diabetes prevalence and complications in India has been observed, leading to an increase in public health issues.[15]

However, epidemiological data of DR and the risk factors among patients with T2D especially in Thai community hospitals were limited. Thus, this study collected data from Tha Wung Hospital, Lop Buri Province central Thailand to determine the incidence and risk factors of DR among patients with T2D over the past decade.

Methods

Study designs and subjects

A retrospective cohort study was conducted between January 1, 2013 and December 31, 2020 to determine the incidence and risk factors of DR among patients with T2D. The data were retrieved from the electronic medical records of patients with T2D visiting Tha Wung Hospital. Inclusion criteria for this study comprised patients with T2D aged at least 18 years receiving medical treatment at the noncommunicable diseases (NCDs) clinic of Tha Wung Hospital. Any patient presenting a history of retinal complication or receiving a diagnosis of DR by the ophthalmologists before 2013 was excluded. The study was reviewed and approved by the Royal Thai Army Medical Department Institutional Reviewed Board (approval number R197h/63).

Data collection

A standardized case report form was used to collect data from the electronic medical records, including demographic characteristics, comorbidities and laboratory test results. Collected data included age, sex, distance between residence area and hospital, risk behaviors including smoking and alcohol consumption, systolic blood pressure (SBP), diastolic blood pressure (DBP), fasting plasma glucose (FPG), hemoglobin A1c (HbA1c), low density lipoprotein cholesterol (LDL), diagnosed DR and comorbidities including hypertension (HT) and dyslipidemia (DLP). T2D was defined by Diabetes Care, 2013 as FPG ≥126 mg/dL and confirmed by repeat testing at a second visit, or HbA1c ≥6.5%.[16] DR was determined according to the International Classification of Diseases, Tenth Revision Codes in E113, presented in medical records.[17] BMI was calculated as body weight in kilograms divided by height in meters squared. The pulse pressure (PP) was calculated as the difference of SBP and DBP levels.

Statistical analysis

Data were analyzed using StataCorp, 2021. *Stata Statistical Software: Release 17*. College Station, TX, USA: StataCorp LLC. Demographic characteristics were presented using descriptive statistics. Categorical data were illustrated as number and percentage while continuous data were illustrated as mean and standard deviation (SD). The incidence rates per 100 person-months of observation were calculated for DR. The person-times of observation of those participants with diagnosed DR were censored at the date of the disease recorded. Multivariate Cox regression analysis was performed to obtain the adjusted hazard ratios (HR) and 95% confidence interval (CI) of the factors related to DR, and statistical significance was set at p-value <0.05.

Results

A total of 2007 patients with T2D was enrolled in the present study. The enrolled participants were aged 59.0±11.0 years. The majority of participants were female (68.7%), and one half of enrolled participants had DLP and HT comorbidities. At baseline, almost 20% of the subjects were current smokers. The average BMI of participants was 26.8±4.7 kg/m². The average of HbA1c level of participants at baseline was 7.4±1.8% while one half of those had HbA1c ≥7%. The average distance between the residential area of participants and hospital was 4.8±4.2 km. The demographic data are presented in **Table 1**.

During the study period, for participants (5.3%) with diagnosed DR; the incidence rate was 0.9 per 100 person-years. (95% CI; 0.7-1.1). **Figure 1** illustrates the cumulative incidence of DR among patients with T2D in relation to HbA1c level ($p<0.001$). Univariate and multi-variate cox regression analyses identifying risk factors for DR are shown in **Tables 2 and 3**. The independent risk factors for DR included HbA1c ≥8% (adjusted hazard ratio (AHR) = 4.7, 95% CI; 2.5-8.7), urine albumin 3+ (AHR = 2.4, 95% CI; 1.1-5.3), urine albumin 4+ (AHR = 20.3, 95% CI; 2.7-150.9), and a longer distance between residential area (AHR= 1.3, 95% CI; 1.2-1.4).

Table 1. Demographic characteristic of participants (n=2007)

Characteristics	n (%)
Gender	
Male	628 (31.29)
Female	1379 (68.71)
Age (year)	59.0±11.0
<40	88 (4.38)
40-59	948 (47.23)
≥60	971 (48.38)
Comorbidities	
Type 2 diabetes (T2D) only	368 (18.34)
T2D with dyalipidemia (DLP)	370 (18.44)
T2D with hypertension (HT)	275 (13.70)
T2D with DLP and HT	994 (49.53)
Current alcohol consumption	
No	1529 (76.34)
Yes	474 (23.66)

Table 1. Demographic characteristic of participants (n=2007) (continue)

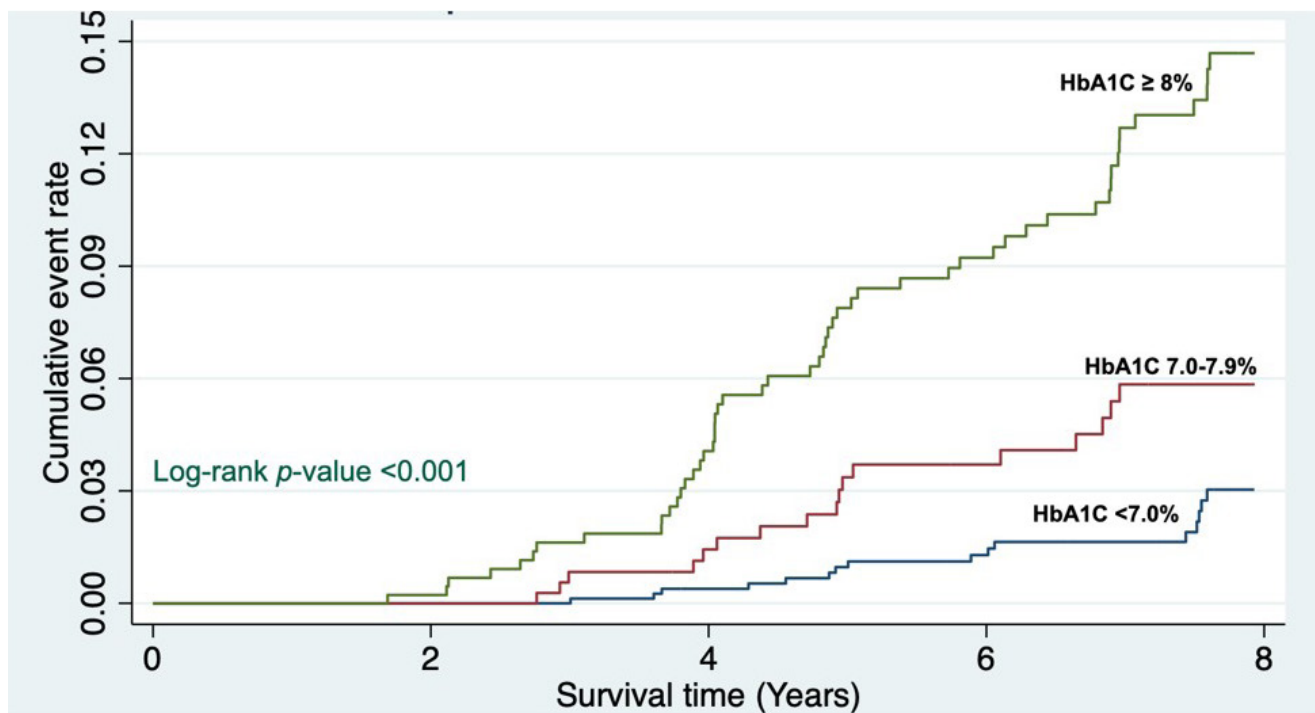| Characteristics	n (%)
Current smoker	
No	1604 (80.04)
Yes	400 (19.96)
Body Mass Index (kg/m²)	26.79±4.74
<18.5	43 (2.18)
18.5-22.99	355 (18.04)
23.0-24.99	358 (18.19)
25.0-29.99	791 (40.19)
≥30.0	421 (21.39)
Fasting blood sugar (mg/dL)	153.69±39.54
HbA1c levels (mg%)	7.41±1.77
<7.0	882 (50.26)
7.0-7.9	402 (22.91)
≥8.0	471 (26.84)
Distance from residential area (km)	2.28±1.82

Figure 1. Cumulative incidence of diabetic retinopathy in patients with type 2 diabetes in relation to HbA1c level.

Table2. Univariate analysis for risk factors of DR among patients with T2D in community hospital, central, Thailand

Factors	Total participants	No. of DR	Person-Years	Incidence Rate (/100 person-years)	Hazard Ratio	95% CI	p-value
Genders	2007	107	11920.36	0.90			
Female	1379	75	8358.37	0.90	1.00		
Male	628	32	3561.99	0.90	1.03	0.68-1.56	0.875
Age (years)	2007	107	11920.36	0.90	0.97	0.95-0.98	<0.001
Current alcohol consumption	2003	107	11920.36				
No	1529	83	8800.95	0.94	1.00		
Yes	474	24	3098.76	0.78	0.78	0.50-1.23	0.289
Current smoker	2004	107	11902.02				
No	1604	84	9256.90	0.91	1.00		
Yes	400	23	2645.12	0.87	0.91	0.57-1.44	0.675
Comorbidities	2007	107	11920.37				
DM only	368	28	1703.69	1.64	1.00		
DM with DLP	370	21	2206.31	0.95	0.51	0.29-0.90	0.020
DM with HT	275	8	1370.12	0.58	0.34	0.15-0.74	0.007
DM with DLP and HT	994	50	6640.25	0.75	0.38	0.24-0.61	<0.001
Duration of DM (months)	1064	65	6666.31	0.98	0.99	0.99-1.00	0.383

Table2. Univariate analysis for risk factors of DR among patients with T2D in community hospital, central, Thailand (continue)

Factors	Total participants	No. of DR	Person-Years	Incidence Rate (/100 person-years)	Hazard Ratio	95% CI	p-value
Body Mass Index (kg/m²)	1968	106	11796.23	0.90	0.96	0.92-1.01	0.093
<18.5	43	4	259.82	1.54	1.00		
18.5-22.9	355	25	2146.89	1.16	0.75	0.26-2.15	0.593
23.0-24.9	358	21	2145.91	0.98	0.64	0.22-1.86	0.411
25.0-29.9	791	39	4763.60	0.82	0.53	0.19-1.49	0.228
≥30.0	421	17	2480.01	0.69	0.45	0.15-1.33	0.147
Systolic blood pressure(mmHg)	1963	106	11778.31	0.90	1.00	0.99-1.02	0.717
<140	1,536	78	8922.51	0.87	1.00		
≥140	427	28	2855.80	0.98	1.06	0.69-1.63	0.797
Diastolic blood pressure (mmHg)	1963	106	11778.31	0.90	1.01	0.99-1.04	0.318
<90	1868	100	11163.19	0.90	1.00		
≥90	95	6	615.12	0.98	1.06	0.46-2.42	0.890
Fasting plasma glucose (mg/dL)	1893	104	1148.84	0.91	1.02	1.01-1.02	<0.001
HbA1c level (mg%)	1755	86	10912.20	0.79	1.37	1.27-1.48	<0.001
<7.0	882	16	5496.35	0.29	1.00		
7.0-7.9	402	17	2467.50	0.69	2.37	1.20-4.68	0.013
≥8	471	53	2948.35	1.80	6.08	3.48-10.64	<0.001

Table 2. Univariate analysis for risk factors of DR among patients with T2D in community hospital, central, Thailand (continue)

Factors	Total participants	No. of DR	Person-Years	Incidence Rate (/100 person-years)	Hazard Ratio	95% CI	p-value
HDL cholesterol level (mg/dL)	1864	104	11348.15	0.92	1.00	0.98-1.02	0.942
<40 in male, <50 in female	882	56	5708.62	0.98	1.00		
≥40 in male, ≥50 in female	982	48	5639.53	0.85	0.91	0.62-1.34	0.641
LDL cholesterol level (mg/dL)	1861	103	11333.40	0.91	1.00	1.00-1.01	0.113
<100	675	38	4136.35	0.92	1.00		
≥100	1186	65	7197.05	0.90	1.00	0.67-1.48	0.972
Total cholesterol level (mg/dL)	1659	38	10197.38	0.37	1.00	1.00-1.01	0.460
<200	1121	23	6929.71	0.33	1.00		
≥200	538	15	3267.67	0.46	1.34	0.70-2.56	0.383
Triglyceride level (mg/dL)	1866	104	11362.55	0.92	1.00	1.00-1.00	0.036
<150	1004	46	6037.94	0.76	1.00		
≥150	862	58	5324.61	1.09	1.42	0.97-2.10	0.074
Urine albumin	1682	86	10338.63				
Negative/Trace	1465	70	9101.81	0.77	1.00		
1+	83	3	462.23	0.65	0.85	0.27-2.70	0.785
2+	74	4	433.82	0.92	1.22	0.45-3.34	0.698
3+	57	8	328.34	2.44	3.23	1.56-6.72	0.002
4+	3	1	12.43	8.04	11.55	1.60-83.21	0.015
Distance from residential area (km)	2007	107	11920.36	0.89	1.30	1.22-1.37	<0.001

Table 3. Multivariate analysis for risk factors of DR among patients with T2D in community hospital, central, Thailand

Factors	Adjusted Hazard Ratio	95% CI	*p*-value
Age (years)	0.98	0.96-1.00	0.116
Male vs Female	1.07	0.65-1.76	0.785
Insulin used	1.25	0.68-2.29	0.467
HbA1c level (%)			
<7.0	1		
7.0-7.9	1.70	0.81-3.59	0.154
≥8	4.70	2.54-8.75	<0.001
Urine albumin			
Negative/Trace	1		
1+	0.71	0.22-2.30	0.581
2+	0.92	0.27-3.06	0.879
3+	2.42	1.11- 5.32	0.026
4+	20.30	2.73-150.92	0.003
Distance from residential area (km)	1.32	1.23-1.42	<0.001

Discussion

The present study illustrated that the cumulative incidence of DR among patients with T2D was 5.33% which was comparable with one related report in Thailand.[10] However, compared with the incidences of DR in T2D in other countries, the incidence of those in this study were relatively low.[5-8] Notably, the cumulative incidences of DR stratified by HbA1c level significantly differed. We found that HbA1c level ≥8% at the time of enrollment was a potential risk for DR. A related nationwide study in Thailand also indicated that the insulin used was associated with DR.[10] This phenomenon could be explained by prolonged elevated blood sugar level and poorly controlled HbA1c leading to small vessels injury and occlusion that accompanied abnormal neovascularization resulting in vascular rupture.[18] Our data suggested that effective interventions such as glycemic controlled should be implemented among patients with T2D to alleviate diabetic complications including DR and other cardiovascular complications. The present study reported that insulin used held a positive relationship to the incidence of DR; nevertheless, this was not statistically significant in the final model.

Our finding reported that higher level of urine albumin screened at baseline was an independent risk for DR among patients with T2D. Similarly, related evidence in Brazil demonstrated that proliferative DR was associated with microalbuminuria among patients with T2D.[19] Furthermore, one related study indicated that an increase in albumin creatinine ratio predicted the risk for DR.[20] The laboratory results of diabetic nephropathy could provide information regarding the severity of current diabetes as shown in our analysis. Albuminuria might represent a state of generalized vascular dysfunction that described a higher risk among patients with high urine albuminuria.[21]

Our study site represented a community hospital and implied the limited setting of public health care resources. Our study presented that a longer distance between residential area and the hospital was related to risk for DR. One related qualitative study in China indicated that lengthy travel times and transportation barriers may affect the quality of care of patients with T2D, leading to the occurrence of complications.[12] Our data suggested that effective interventions such as fundoscopic exam and teleophthalmology for remote grading should be provided at the community level including primary care units. Further, patients with T2D should be encouraged to receive appropriate care.[22]

According to secondary data used for analysis, some variables were incomplete. Another limitation was the small sample size in the study; therefore, the association between well-known risk factors such as elevated blood pressure, cholesterol level and outcome could not be presented. The result of our study may not be generalized to the whole country but may reflect the real situation of patients with T2D visiting a Thai community hospital.

Conclusion

We reported the incidence and risk factors of DR among patients with T2D visiting a community hospital. Patients with T2D should be encouraged to reach their glycemic control indicated by HbA1c level. Additionally, effective health interventions should be conducted to contribute to appropriate access to diabetic care for patients residing in remote areas.

Conflict of interest

The authors declare they have no conflict of interest.

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