ORIGINAL ARTICLE

Clinical features of diabetes retinopathy in elderly patients with type 2 diabetes in Northern Chinese

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Abstract

Objective: The objective was to estimate the prevalence and clinical characteristics of diabetes retinopathy (DR) in elderly individuals with type 2 diabetes mellitus in Northern Chinese.

Materials and Methods: 595 eligible subjects (263 men, 332 women) assisted by the community health service center in Beijing, China were involved with averaged 70.6 ± 8.8 years old and male ratio is 0.44. All subjects were interviewed face to face by questionnaire and underwent the extensive physical examinations including ophthalmologic and systemic conditions.

Results: Prevalence of DR was 17.1% and DR was significantly associated with nephropathy (odds ratio [OR]: 4.17, 95% confidence interval [CI]: 1.829–17.577, *P* = 0.001), arteriosclerosis of retina (OR: 0.41, 95% CI: 0.207–1.102, *P* = 0.01), diabetic foot gangrene, (OR: 5.32, 95% CI: 1.674–30.063, *P* = 0.001), diabetic neuropathy (OR: 5.23, 95% CI: 2.896–17.334, *P* = 0.001), hypertension (HTN) (OR: 1.70, 95% CI: 0.990–3.923, *P* = 0.05). Clinical characteristics of DR by risk factors analysis were polydipsia (OR: 2.73, 95% CI: 1.716–6.567, *P* = 0.001), polyuria (OR: 2.06, 95% CI: 1.303–5.005, *P* = 0.001), polyphagia (OR: 1.80, 95% CI: 1.127–4.499, *P* = 0.01), weakness (OR: 2.00, 95% CI: 1.264–4.825, *P* = 0.001), high blood lipid (45.76%), high blood sugar (22.89%), and renal dysfunction (12.33%).

Conclusions: Diabetes retinopathy in elderly diabetes patients in Northern Chinese is prevalent and associated with these chronic complications such as HTN, nephropathy, arteriosclerosis of retina, diabetic foot gangrene, and diabetic neuropathy.

Key words: Diabetes mellitus, diabetic retinopathy, elderly, Northern Chinese

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Introduction

Diabetic retinopathy (DR) is a leading cause of visual impairment and blindness in patients with diabetes mellitus (DM).[1,2] Most cases with DM (>75%) will eventually develop DR within 20 years after the diagnosis of diabetes.[3] Because the prevalence of diabetes increased with aging increment in the general population, the DR rate in elderly people would be higher than those in the other age-specific groups. It is, therefore, important to know the prevalence of DR and its risk factor distribution in the elderly population with DM, as a key indicator of diabetic microvascular complications.

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With aging population increasing, changes in the lifestyle and urbanization in large cities of China, the prevalence of diabetes and DR are rapidly increasing in parallel.[4,5] Previous studies have shown that duration of diabetes, hyperglycemia, and hypertension (HTN) are the major independent risk factors for DR[6-10] and some studies had reported the DR prevalence in adult or general population,[11-14] but few papers reported data on the DR prevalence and the risk factors of clinical traits in elderly.

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To our knowledge, the available data on the prevalence and risk factors of clinical characteristics of DR in elderly individuals with type 2 diabetes (T2D) in community-dwelling people have been limited, and the data from different adult population cannot completely be compared to those in elderly, because the development of DM with DR depends on age, genetic backgrounds, lifestyle, and food constitution.[15] We, therefore, conducted the study to describe the prevalence and risk factors of clinical characteristics associated with DR in elderly individuals with T2D in community-dwelling people in Beijing, China. To compare the differences and identify the association of clinical characteristics with DR, we randomly selected Chinese diabetic patients with DR and without DR, from 5,000 local Chinese community-dwelling elderly residents. We developed the study with an aim to determine the prevalence and risk factors of clinical characteristics of DR in elderly individuals with T2D in Northern Chinese.

Materials and Methods

Subjects

This is a community-based, observational, cross-sectional study, 595 eligible subjects (263 men, 332 women) with DM assisted by the community health service center in Beijing, China were surveyed in Chinese aged over 60 years from Beijing in 2012. Mean age of participants was 70.6 ± 8.8 years, and male ratio is 0.44. The study was approved by the Beijing Hospital Ethical Committee and written informed consent was obtained from all participants. All subjects were interviewed face to face by questionnaire and underwent the extensive physical examinations. All subjects confirmed by the eye clinic of Beijing Hospital for a detailed examination including standardized interview, ophthalmologic and systemic conditions, and laboratory investigations for fasting blood samples.

We defined that the inclusions of all subjects involved were diabetic patients diagnosed; age more than 60 years old; permanent residence living in Beijing downtown for 5 years at least. For the exclusion of patients who were severely disabled, who showed hepatic or renal failure, or who had schizophrenia or goiter may have influenced the results of the study. DM was defined using the World Health Organization criteria, and diabetic retinopathy was graded from fundus photographs according to the modified Early Treatment Diabetic Retinopathy Study classification system[16] in all subjects. All diabetic patients with DR included nonproliferative diabetic retinopathy and proliferative diabetic retinopathy in this study. Subjects were grouped to two, one group including 95 cases with DR, and the other having 442 patients with non-DR.

All participants underwent a standardized interview with a form to record the clinical information of each patient, including personal history (smoking, alcohol consumption, and physical activity), family history, history of present illness, and information associated with other diseases. And clinical examinations were recorded including the duration of DM, medical history of DM, body weight, height, waist circumference, hip circumference, neck circumference, heart rate, resting blood pressure (measured while seated after 30 min of rest) and the collection of blood and urea samples to determine the levels of fasting plasma glucose, 2-h postprandial blood glucose (HPG), glycosylated hemoglobin, total cholesterol (TC), triglyceride (TG), high-density lipoprotein cholesterol (HDL-C), low-density lipoprotein cholesterol (LDL-C), alanine aminotransferase, and blood urea nitrogen (BUN), creatinine (CR), urea protein and microalbuminuria (MAU).

Participants received anterior segments and fundus examination following the mydriasis to assess the ocular diseases under slit lamp microscope and indirect ophthalmoscope. 45° photographs of the central fundus were taken from all eyes using digital retinal camera (TRC-50IX, Topcon Corp., Tokyo, Japan). Diabetic retinopathy was graded from the fundus photographs.

Statistical analysis

Statistical analysis was performed using SPSS (version 17.0) software (SPSS, Chicago, IL, USA). Continuous variables were presented as mean ± standard deviation (SD) by ANOVA analysis. Categorical variables were expressed as a number or relative number (percent). The risk association between DR and the variables was estimated. The data were first tested for a normal distribution, and the variables with skewed distributions were further analyzed only after logarithmic transformation. Chi-square tests for categorical data were used to compare the prevalence of complications and the risk association of clinical characteristics with DR in diabetes patients and Fisher test (depending on normality of the distribution and expected frequencies). Bivariate logistic regression analysis was performed to identify risk factors associated with DR and odds ratios (ORs) with 95% confidence interval (CI) were provided. The ratio of risk clinical characteristics contribution to DR was calculated by principal component analysis method. We set $P < 0.05$ (two-sided) with statistically significant in this study.

Results

Clinical baseline characteristics

We identified a total of 595 patients who were randomly selected from 5,000 local Chinese community-dwelling elderly residents. In them, 537 (90.3%) individuals

were eligible for the study and 95 subjects with diabetic retinopathy were detected, resulting in a crude rate of 17.0%. The prevalence adjusted by age was 21.0% in Chinese elderly DM patients. The Clinical baseline characteristics data were given as mean ± SD and calculated statistical significance of the differences between the two groups as shown in Table 1. Mean age of 442 individuals in non-DR group was 70.62 ± 8.92 years and ratio of female was 0.55. Mean age of 95 individuals in DR group was 70.52 ± 8.30 years and ratio of female was 0.60.

Demographic and clinical baseline data from baseline characteristics of 2 groups (non-DR and DR), only Duration of diabetes (non-DR: 6.76 ± 5.06 years vs. DR: 12.30 ± 6.90 years; $P = 0.014$), BUN (non-DR: 7.10 ± 9.43 mmol/L vs. DR: 17.87 ± 73.09; $P = 0.02$) and MAU (non-DR: 41.59 ± 63.35 mg/gCr vs. DR: 589.64 ± 2054.74; $P = 0.014$) were significantly associated with the occurrence of DR. And the other 20 clinical characteristics had not observed the significant differences between two groups [$P > 0.05$ and Table 1].

Ophthalmologic and systemic complications

Chi-square test as shown in Tables 2 and 3, of ocular diseases, only arteriosclerosis of retina (non-DR: 22.20% vs. DR: 10.50%; $P = 0.025$), was significantly associated with DR [Table 2]. And of system diseases, nephropathy (non-DR: 3.19% vs. DR: 12.09%; $P < 0.001$), diabetic neuropathy (non-DR: 7.16% vs. DR: 28.74%; $P < 0.001$), diabetic foot gangrene (non-DR: 1.40% vs. DR: 6.80%; $P < 0.001$), were significantly associated with DR [Table 3].

Analysis of diabetes retinopathy risk factors

The clinical characteristics information and DR with complications status collected at Tables 2 and 3 were used to predict the occurrence risk of DR during the study. DR served as dependent variables, the data items including polydipsia, polyuria, polyphagia, weakness, smoking, weight loss, HTN, dyslipidemia, nephropathy, diabetic neuropathy, diabetic foot gangrene, glaucoma, macular diseases, vitreous diseases, arteriosclerosis of retina etc., served as independent variables. By logistic regression analysis, as shown in Table 4, it revealed that nine risk factors were significantly associated with the occurrence risk of DR, including polydipsia (OR: 2.73, 95% CI: 1.716–6.567, $P = 0.001$), polyuria (OR: 2.06, 95% CI: 1.303–5.005, $P = 0.001$), polyphagia (OR: 1.80, 95% CI: 1.127–4.499, $P = 0.01$), weakness (OR: 2.00, 95% CI: 1.264–4.825, $P = 0.001$), nephropathy (OR: 4.17, 95% CI: 1.829–17.577, $P = 0.001$), arteriosclerosis of retina (OR: 0.41, 95% CI: 0.207–1.102, $P = 0.01$), diabetic foot gangrene, (OR: 5.32, 95% CI: 1.674–30.063, $P = 0.001$), diabetic neuropathy (OR: 5.23, 95% CI: 2.896–17.334, $P = 0.001$), HTN (OR: 1.70, 95% CI: 0.990–3.923, $P = 0.05$).

Table 1: Clinical baseline characteristics (Mean+std. deviation) between diabetic patients without DR and with DR

Phenotypes	Non-DR (n=442)		DR (n=95)		F	P
Age (years)	70.62	8.920	70.52	8.303	0.437	0.646
Gender (woman)	0.55	0.498	0.60	0.492	1.494	0.225
Height (cm)	161.92	13.715	160.42	12.768	1.635	0.196
Weight (kg)	66.66	12.157	64.89	9.892	1.553	0.213
Waist circumference (cm)	89.5	12.74	88.78	8.762	0.143	0.867
Hip circumference (cm)	98.87	8.9	96.88	6.589	1.689	0.186
Neck circumference (cm)	35.98	4.544	35.83	3.903	0.195	0.823
Systolic pressure (mmHg)	131.5	15.75	130.87	14.364	0.116	0.89
Diastolic pressure (mmHg)	78.16	11.411	76.13	8.722	2.026	0.133
Duration of diabetes (years)	6.76	5.060	12.30	6.900	6.249	0.014
Heart rate (bpm)	73.51	7.348	73.21	6.841	0.616	0.541
FPG (mmol/L)	10.564	19.7584	15.893	66.9228	0.903	0.406
HPG (mmol/L)	10.771	7.2148	11.935	16.2721	0.445	0.641
HBA1C(%)	7.327	2.5992	7.382	1.5546	0.04	0.961
TG (mg/dl)	5.6207	23.26077	1.8987	1.40323	1.089	0.337
TC (mg/dl)	11.0979	36.89846	11.4244	52.70328	0.029	0.971
HDLC (mg/dl)	5.747	14.0835	8.566	19.1109	1.341	0.263
LDLC (mg/dl)	13.203	33.6425	18.495	41.7228	0.914	0.402
ALT (U/L)	22.075	13.1552	23.13	18.175	0.265	0.768
BUN (mmol/L)	7.103	9.4239	17.871	73.0906	3.927	0.02
Creatinine (umol/L)	74.98	26.151	80.22	29.913	1.961	0.142
Microalbuminuria (mg/gCr)	41.59	63.35	589.64	2054.737	6.249	0.014
Urea protein (mg/gCr)	65.07	129.561	121.08	126.967	0.735	0.405

DR=Diabetes retinopathy, FGP=Fasting plasma glucose, HGP=Postprandial blood glucose, HbA1c=Glycosylated hemoglobin, TC=Total cholesterol, TG=Triglyceride, HDL-C=High-density lipoprotein cholesterol, LDL-C=Low-density lipoprotein cholesterol, ALT=Alanine aminotransferase, BUN=Blood urea nitrogen, DR=Diabetes retinopathy

By clustering risk factors of qualitative indicators from the results of laboratory investigation in diabetic patients with DR, as shown in baseline Table 1, the significant category of risk factors of DR was blood dyslipidemia (i.e. TC), high glucose (i.e. HPG, low HDL-C, and renal dysfunction (i.e. serum Cr) by factor analysis, seeing in Table 5. The components of risk factors contributing the rate to DR were as follow, dyslipidemia (31.04%), high glucose (22.88%), low HDL-C (14.72%), and renal dysfunction (12.33%). All four components explained 80.97% risk of DR in Chinese elderly diabetic patients.

Table 2: Comparison analysis by DR complicated with ophthalmology diseases

Diseases	Number (%)		χ^2	*P*
	Non-DR	DR		
Glaucoma	22 (5.00)	3 (3.20)	0.733	0.693
Arteriosclerosis of retina	98 (2.20)	10 (10.50)	7.382	0.025
Vitreous diseases	6 (1.40)	3 (3.20)	1.598	0.45
Macular diseases	37 (7.20)	7 (7.40)	0.902	0.924
Cataract	106 (24.00)	22 (23.20)	1.415	0.842

DR=Diabetes retinopathy

Table 3: Comparison analysis by DR complicated with different diseases

Diseases	Number (%)		χ^2	*P*
	Non-DR	DR		
HTN	308 (69.80)	75 (79.80)	5.889	0.053
Stroke	69 (15.60)	18 (19.40)	1.376	0.502
CHD	107 (24.30)	28 (29.80)	1.355	0.508
Hyperlipidemia	184 (42.00)	41 (45.10)	0.996	0.608
Tumor	7 (1.70)	1 (1.10)	0.220	0.896
Mental disease	4 (0.90)	1 (1.10)	0.052	0.974
PHD	1 (0.20)	1 (1.10)	1.502	0.472
Hepatitis	9 (2.00)	2 (2.20)	0.068	0.967
Pancreatitis	2 (0.50)	1 (1.10)	0.551	0.759
Nephropathy	14 (3.19)	11 (12.09)	13.280	<0.001
Diabetic neuropathy	31 (7.16)	25 (28.74)	35.636	<0.001
Diabetic foot gangrene	6 (1.40)	6 (6.80)	187.000	<0.001

DR=Diabetes retinopathy; HTN=Hypertension; CHD=Coronary heart disease; PHD=Pulmonary heart disease

Table 4: Logistic regression analysis of DR risk factors

	DR	non-DR	*P*	OR	95% CI	
Polydipsia	55/36	158/282	0.001	2.73	1.716	6.567
Polyuria	47/42	154/284	0.001	2.06	1.303	5.005
Polyphagia	38/51	128/309	0.01	1.80	1.127	4.499
Weakness	48/42	159/278	0.001	2.00	1.264	4.825
Nephropathy	11/80	14/425	0.001	4.17	1.829	17.577
Arteriosclerosis of retina	10/85	98/344	0.01	0.41	0.207	1.102
Diabetic foot gangrene	6/82	6/436	0.001	5.32	1.674	30.063
Diabetic neuropathy	25/62	31/402	0.001	5.23	2.896	17.334
HTN	75/19	308/133	0.05	1.70	0.990	3.923

OR=Odds ratio, CI=Confidence interval, DR=Diabetes retinopathy; HTN=Hypertension

Discussion

The age-adjusted prevalence of diabetic retinopathy in our study was 21.0% lower than the estimated prevalence of diabetic retinopathy which is 28.5% among US adults with diabetes.[10] The prevalence of diabetic retinopathy reported in our study was close to the results from population-based investigations from India where the prevalence of diabetic retinopathy in diabetic subjects ranged from 17.6% to 26.8%,[17-19] but considering aging factor, which is an important risk factor of DR, the prevalence of DR in the elderly population should be higher. We think that the differences may be derived from the heterogeneous nature of the research power, sample size, genetic background, lifestyle, food etc., among different population. Hence, it is necessary for us to study it in a larger sample of the elderly population in the future.

Our study showed that diabetes cases with DR had nearly 2 times longer average duration of diabetes than that of patients without DR (12.30 vs. 6.76 years, $P = 0.014$), Similar associations were found by Zhang *et al*. in the recent study on the prevalence of diabetic retinopathy in US adults with DM.[10] As our investigation, the study by Zhang *et al*. revealed an association between the prevalence of diabetic retinopathy and longer duration of diabetes (OR, 1.06; 95% CI, 1.03–1.10).

In bivariate logistic regression analysis, presence of diabetic retinopathy was significantly associated with polydipsia (OR: 2.73, 95%: 1.72–6.57, $P = 0.001$), polyuria (OR: 2.06, 95%: 1.30–5.01, $P = 0.001$), polyphagia (OR: 1.80, 95%: 1.13–4.50, $P = 0.01$), weakness (OR: 2.00, 95%: 1.26–4.83, $P = 0.001$), nephropathy (OR: 4.17, 95%: 1.83–17.58, $P = 0.001$), arteriosclerosis of retina (OR: 0.41, 95%:0.21–

Table 5: Factor analysis of the category of risk factors contributing to DR

Component	Initial eigenvalues			Extraction sums of squared loadings		
	Total	Percentage of variance	Cumulative %	Total	Percentage of variance	Cumulative %
Dyslipdemia	3.725	31.039	31.039	3.725	31.039	31.039
High glucose	2.746	22.882	53.921	2.746	22.882	53.921
Low HDL-C	1.766	14.718	68.640	1.766	14.718	68.640
Renal dysfunction	1.479	12.329	80.969	1.479	12.329	80.969

Method: Principal component analysis. DR=Diabetes retinopathy; HDLc=High-density lipoprotein cholesterol

1.10, $P = 0.01$), diabetic foot gangrene (OR: 5.32, 95%:1.67–30.06, $P = 0.001$), diabetic neuropathy (OR: 5.23, 95%: 2.90–17.33, $P = 0.001$), and HTN (OR: 1.70, 95%: 0.99–3.92, $P = 0.05$) [Table 4]. In agreement with previous studies, patients with symptoms and complications of DM had a significantly increased prevalence of diabetic retinopathy [Tables 2 and 3].[13] In a similar manner, the highly significant association of HTN with the prevalence of diabetes in this study conforms with previous investigations.[20]

In risk factor component study, presence of diabetic retinopathy was associated with dyslipidemia, higher concentration of serum glucose, lower HDL-C, and renal dysfunction. And the contribution rate to diabetic with DR was significant difference among the four categories of risk factors of DR. We identified four components of risk contributing rate to DR included dyslipidemia (31.04%), high glucose (22.88%), low HDL-C (14.72%), and renal dysfunction (12.33%). All four components explained 80.97% risk of DR in Chinese elderly diabetic patients seen [Table 5]. In them, aggregate risk contributing rate to DR for dyslipidemia was more than 45%, but the any single lipid measure including TC [$P > 0.05$], LDL-C [$P > 0.05$], HDL-C [$P = 0.32$], and TGs [$P = 0.24$]) were not significantly associated with diabetic retinopathy in our investigation [Table 1]. The associations of lipids with diabetic retinopathy were investigated in multiple population-based studies and clinical trials, but the findings have remained inconsistent.[21-23] TC was an independent risk factor for diabetic retinopathy in the Chennai Urban Rural Epidemiology Study but was protective of diabetic retinopathy in the Singapore Malay Eye Study population.[21,24] Other studies reported that serum lipids were associated with retinal hard exudates and diabetic macular edema.[23,25] The Multi-Ethnic Study of Atherosclerosis did not find any association of serum lipids with diabetic retinopathy.[26]

Limitations of our study should be mentioned again. First, it was a small sample investigation, which does not allow conclusions on risk factors; however, it only allows conclusions on associated factors for diabetic retinopathy. Second, instead of 7 field fundus photographs, we used 45^0 photographs of the central fundus as basis for the assessment of diabetic retinopathy. Strengths of our study was first time to search for Chinese elderly diabetes patients (>60 years) with DR, the masked grading of the retinal photographs of both eyes using an internationally accepted grading scheme; and that the study was performed as a clinic study based on local residents in Beijing, China.

We concluded that in Chinese elderly diabetes patients with DR, these clinical characteristics namely polydipsia, polyuria, polyphagia, weakness, and the following co-morbidities e.g., nephropathy, diabetic neuropathy, diabetic foot gangrene, arteriosclerosis of retina, and HTN are highly significantly associated with risk of diabetic retinopathy. In spite of these, associated factors for diabetic retinopathy in our Chinese elderly diabetes population were similar to those reported previously for white patients with nutritional and cultural differences. Further study is needed to know the distribution spectrum of risk factors with ageing increment in Chinese elderly diabetes patients (>60 years) with DR, for potential application for clinic treatment and prevention program.

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