Family Medicine and Community Health
ORIGINAL RESEARCH

Four-year dynamic observation and study on standardized management of elderly patients with type 2 diabetes in Beijing Yongding Road Community

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Abstract

Purpose: This study aimed to understand the joint standard of blood glucose, blood lipids, and blood pressure in elderly patients >60 years of age with type 2 diabetes in the Beijing Yongding Road Community.

Methods: One hundred ninety-two elderly patients >60 years of age who were diagnosed with type 2 diabetes in Yongding Road Community served as the investigation subjects, underwent standard management, and the dynamic changes in blood glucose, blood lipids, and blood pressure were monitored for 48 months.

Results: At the end of the observation period, the standard rates of fasting blood glucose and postprandial blood glucose were 72.55% and 80.00%, respectively, which were increased compared with 55.73% and 56.08% at baseline ($P<0.01$). The standard rate of HbA1c was 59.81%, which was increased compared with 53.44% at baseline ($P>0.05$). The standard rates of TG and LDL-C were 76.71% and 60.38%, respectively, which were increased compared with 54.69% and 34.74% at baseline, and the standard rate of HDL-C was 13.64%, which was decreased compared with 40.10% at baseline ($P<0.01$). The standard rate of BP was 58.33%, which was increased compared with 38.54% at baseline ($P<0.01$). The optimal control rate of blood glucose for 48 months (the standard times of the total measurement times in 48 months ≥75%) was higher; the fasting blood glucose was 52.17%, the 2-h postprandial blood glucose was 60.22%, and the HbA1c was 46.45%. The optimal control rate of blood lipids was lower; LDL-C was 17.49% and HDL-C was 13.59%. The optimal control rate of BP was 9.13%. At the end of the observation period, the levels of fasting blood glucose and postprandial blood glucose were decreased by 0.7 mmol/L and 1.48 mmol/L, respectively, compared with the baseline ($P<0.01$). The level of HbA1c was decreased by 0.18% compared with the baseline ($P<0.05$). The levels of LDL-C and HDL-C were decreased by 0.4 mmol/L and 0.23 mmol/L, respectively, compared with the baseline ($P<0.01$). The levels of SBP and DBP were decreased by 4 mmHg compared with the baseline ($P<0.01$). At the end of the observation period, the joint standard rate of the three indices of HbA1c, LDL-C, and BP was 24.72%, which was increased compared with 6.25% at baseline ($P<0.01$).

Conclusion: Standardized management of elderly patients with diabetes in the Community can improve the joint standard rate of blood glucose, blood lipids, and blood pressure. The optimal control rate and joint standard rate are the important indices for evaluating the quality of diabetes management.

Keywords: Type 2 diabetes mellitus, Community, Management, Joint standard rate

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Introduction

With continuous improvement in living standards and the aging population in Chinese cities, the number of patients with diabetes in China has reached one hundred million [1]. Patients with diabetes always have multiple metabolic disorders. To reduce the complications associated with diabetes, when blood glucose is controlled, we attach more and more importance to joint standards of blood lipid and blood pressure. Since August 2008, we made dynamic observations on the standards of blood glucose, blood lipids, and blood pressure for 192 elderly patients with type 2 diabetes under standard management in the Beijing Yongding Road Community for 48 months.

Subjects and methods

Research subjects

The patients were recruited between June and August 2008, and were observed from August 2008 to July 2012. The subjects were 192 elderly patients >60 years of age with type 2 diabetes in the center and five subordinate commodity stations of Beijing Yongding Road Community, who complied with the diagnostic standards of WHO in 1999. The exclusion criteria were as follows: patients with a high level of residential mobility and hard to visit on a regular basis; patients with serious movement disorders and hard to visit the Community on a regular basis; patients whose brain functions are decreased or who suffer from moderate and severe dementia due to particularity of work; patients taking glucocorticoids orally for a long duration of time; patients whose alanine aminotransferase is 2.5 times greater than normal, but cannot be explained by a fatty liver; patients with severe renal impairment (serum creatinine >200 μmol/L); patients with moderate and severe schizophrenia; and patients participating in other clinical tests. Of the patients investigated this time, there were 85 males and 107 females, with an average age of 68±5 years. The average course of diabetes was 9 years. One hundred forty-four patients (75.0%) had co-existing hypertension, 110 patients (57.3%) had co-existing dyslipidemia, 32 patients (16.7%) had co-existing coronary heart disease, and 14 patients (7.3%) had a history of stroke. One hundred seventy-eight patients (92.7%) took hypoglycemic drugs when they are enrolled. Forty-two patients (21.88%) took insulin, 139 patients (72.40%) took anti-hypertensive drugs, and 40 patients (20.83%) took anti-lipidemic drugs. At the end of the observation period, there were 184 patients and the exclusion rate was 4.17%. It was determined that there were no follow-up visits and record reviews within 1 year prior to July 2012. During the observation period, the data at various time points was collected from those who were not excluded at that time.

Research methods

Organize training for the community physicians participating in this research, and standardize investigation methods and fill in the specially-designed investigation form uniformly.

Patients were required to measure blood glucose and blood pressure every 2 months, HbA1c every 3 months, and blood lipids every 6 months. Blood glucose and blood lipids were measured using an enzymatic method with an Olympus AU2700 [Tokyo, Japan]. HbA1c was measured using a HPLC method with a Tosoh HLC-723G7 [Tokyo, Japan]. The aforementioned examinations were completed in the Examination Department of Aerospace Central Hospital. The authors received consent from all participants.

Standards: By reference to the diabetes treatment guidelines of China in 2010 [2], a fasting blood glucose between 3.9 and 7.2 mmol/L, a non-fasting blood glucose <10 mmol/L, a HbA1c <7%, a LDL-C not combined with coronary heart disease <2.6 mmol/L and combined with coronary heart disease <1.8 mmol/L, and a blood pressure <130/80 mmHg were considered normal. Optimal control was defined as achieving a standard ≥75% of the total evaluation times for 48 months and poor control was defined if the times of achieving a standard <75% [3, 4]. The joint standard rate used HbA1c+ blood pressure, HbA1c+LDL-C, and HbA1c+ blood pressure +LDL-C.

Statistical method: Data entry used Epidata 3.1, and SPSS 17.0 statistical software was adopted for statistical analysis. The measurement data are expressed as x±s. A matched *t*-test was performed for comparison before and after observation. The frequency and rate were adopted for statistical description of enumeration data, and the χ^2 test was conducted for comparison before and after observation. A $P<0.05$ was considered to be statistically significant.

Management strengthening work: Community physicians participated in management symposia regularly. Once overall statistical treatment should be made for all data 2 years after management. According to the blood lipid control rate and main factors influencing the low joint standard rates in work, schemes for strengthening treatment of hyperlipidemia were raised.

Results

Taking the 0 month data as the baseline, at the end of the observation period the body mass index (BMI) of patients was 24.33±3.23 kg/m^2, which was reduced compared with 24.70±3.17 kg/m^2 at baseline (P>0.05).

At the end of the observation period, the number of patients taking hypoglycemic drugs was 179 (93.23%), which was increased by 1 patient compared with 178 (92.71%) at baseline. The number of patients not taking any hypoglycemic drugs was 13 (6.77%), which was reduced by 1 patient compared with 14 (7.29%) at baseline. The number of patients taking biguanides, α-glycosidase, and insulin for treatment was increased compared with baseline, and the difference was statistically significant (biguanides and α-glycosidase [P<0.05], and insulin [P<0.01]). At the end of the observation period, the number of patients taking single hypoglycemic drugs was reduced, while the number of patients taking more than two hypoglycemic drugs was increased significance (P<0.01).

At the end of the observation period, the number of patients taking antihypertensive drugs was 145 (75.52%), which was increased by 1 patient compared with 139 (72.40%) at baseline. The number of patients taking a calcium ion antagonist and β-receptor antagonist was increased compared with baseline (P<0.01). The number of patients taking single antihypertensive drugs was reduced (P<0.05), while the number of patients taking more than two antihypertensive drugs was increased (P<0.01).

The number of patients taking statins was 58 (30.21%), which was increased compared with 37 (19.27%) at baseline (P<0.01). During the observation period, only four patients took fibrates. The number of patients taking fibrates and hypoglycemic drugs is shown in Table 1.

The standard rates of fasting blood glucose and postprandial blood glucose were 72.55% and 80.00%, respectively, which were increased compared with 55.73% and 56.08% at baseline (P<0.01). The standard rate of HbA1c for only 36 months was 71.97%, which was increased compared with 53.44% at baseline (P<0.01). The standard rates of other periods were higher than the baseline (P>0.05).

Table 1. Types of hypoglycemic, anti-hypertensive, and hypolipidemic drugs used by T2DM patients

	0 Months n(%)	48 Months n(%)
Hypoglycemic drugs		
Sulfonylurea	64(33.33)	64(33.33)
Metformin	89(46.35)	93(48.44)*
α-glucosidase inhibitor	103(53.65)	106(55.21)*
Nateglinide	50(26.04)	48(25.00)
Thiazolidinedine	10(5.21)	5(2.60)
Insulin	42(21.88)	52(27.08)†
None	14(7.29)	13(6.77)
One kind of medication	46(23.96)	34(17.71)†
≥Two kinds of medications	132(68.75)	145(75.52)†
Anti-hypertensive drugs		
Calcium channel blockers	102(53.13)	114(59.38)†
ARB	48(25.00)	54(28.13)
β-blockers	36(18.75)	49(25.52)†
ACEI	38(19.79)	36(18.75)
Diuretics	10(5.21)	9(4.69)
One kind of medication	64(47.04)	52(35.86)*
≥Two kinds of medications	75(53.96)	93(64.14)†
Hypolipidemic drugs		
Statins	37(19.27)	58(30.21)†
Fibrates	4(2.08)	4(2.08)

Compared with baseline *P<0.05; †P<0.01.

The standard rates of TG and LDL-C were 76.71% and 60.38%, respectively, which were increased compared with 54.69% 34.74% at baseline (P<0.01). The standard rate of HDL-C was 13.64%, which was reduced compared with 40.10% at baseline (P<0.01). Comparing the standard rates of TC during various periods with the baseline, the differences had no statistical significance (P>0.05).

The standard rates of SBP, DBP, and BP were 64.10%, 82.05%, and 58.33%, respectively, which were increased compared with 45.83%, 59.90%, and 38.54% at baseline (P<0.01). The standard rates of blood glucose, blood lipids, and blood

pressure during various periods are shown in Table 2. The changes of standard rates of HbA1c, SBP, DBP, and LDL-C in 48 months are depicted in Fig. 1.

The optimal control rates of fasting blood glucose, postprandial blood glucose, and HbA1c for 48 months were higher. The optimal control rate of TG was the highest and HDL-C was the lowest. The optimal control rate of BP was 19.13%. The optimal control rate of DBP was 76.09%, while SBP was lower (22.28%). The optimal control rates of various indices of blood glucose, blood lipids, and blood pressure are shown in Table 3.

At the end of the observation period, the joint standard rates of the two indices of HbA1c+LDL-C and HbA1c+BP were 40.00% and 41.75%, respectively, which were doubled compared with 17.19% and 20.83% at baseline, and the joint standard rates of the three indices of HbA1c+LDL-C+BP was 24.27%, which was almost triple compared with 6.25% at baseline (P<0.01). The changes in joint standard rates of blood glucose, blood lipids, and blood pressure for 48 months are shown in Table 4.

At the end of the observation period, the levels of fasting blood glucose and postprandial blood glucose were 6.94 mmol/L and 8.96 mmol/L, respectively, which were reduced by 0.7 mmol/L and 1.48 mmol/L compared with 7.64 mmol/L and 10.44 mmol/L at baseline (P<0.01). The level of HbA1c was 6.88%, which was reduced by 0.18 mmol/L compared with 7.06% at baseline (P<0.05).

The levels of TG (1.57 mmol/L) and TC (4.71 mmol/L) were reduced by 0.27 mmol/L and 0.29 mmol/L, respectively, compared with 1.84 mmol/L and 5.00 mmol/L at baseline (P<0.05). The levels of LDL-C (2.55 mmol/L) and HDL-C (0.92 mmol/L) were reduced by 0.4 mmol/L and 0.23 mmol/L, respectively, compared with 2.95 mmol/L and 1.15 mmol/L at baseline, and the difference had statistical significance (P<0.01).

Table 2. The standard rates of blood glucose, blood lipids, and blood pressure for elderly patients with type 2 diabetes for different months (n/N)

Index	Baseline	6 months	12 months	18 months	24 months	30 months	36 months	42 months	48 months
Fasting blood glucose	55.73 (107/192)	62.05 (103/166)	62.73 (101/161)	66.67* (120/180)	61.49 (99/161)	62.64 (114/182)	69.54† (121/174)	66.47† (115/173)	72.55† (111/153)
2-h postprandial blood glucose	56.08 (106/189)	73.62† (120/163)	78.18† (129/165)	71.59† (126/176)	78.62† (125/159)	76.37† (139/182)	74.30† (133/179)	81.18† (138/170)	80.00† (124/155)
HbA1c	53.44 (101/189)	66.00 (66/100)	56.90 (66/116)	61.11 (77/126)	60.33 (73/121)	58.62 (102/174)	71.97† (95/132)	62.09 (95/153)	59.81 (64/107)
TG	54.69 (105/192)	64.23 (79/123)	61.36 (81/132)	62.31 (81/130)	69.23† (90/130)	70.06† (124/177)	62.68 (89/142)	59.70 (80/134)	76.71† (69/105)
TC	33.33 (64/192)	37.70 (46/122)	34.31 (47/137)	29.01 (38/131)	33.85 (44/130)	37.85 (67/177)	44.85 (61/136)	35.25 (49/139)	40.38 (42/104)
LDL-C	34.74 (66/190)	35.94 (46/128)	33.85 (44/130)	28.35 (36/127)	26.52 (35/132)	26.55 (47/177)	44.06 (63/143)	49.63† (67/135)	60.38† (64/106)
HDL-C	40.10 (77/192)	39.06 (50/128)	32.62 (46/141)	26.19† (33/126)	23.84† (36/151)	15.82† (28/177)	21.13† (30/142)	20.16† (26/129)	13.64† (15/110)
SBP	45.83 (88/192)	49.70 (84/169)	49.41 (84/170)	54.24 (96/177)	56.02 (93/166)	50.00 (91/182)	60.77† (110/181)	65.32† (113/173)	64.10† (100/156)
DBP	59.90 (115/192)	74.56† (126/169)	76.88† (129/170)	81.36† (144/177)	82.33† (135/166)	78.02† (142/182)	80.66† (146/181)	86.71† (150/173)	82.05† (128/156)
BP	38.54 (74/192)	42.60 (72/169)	38.82 (66/170)	45.20 (80/177)	48.80 (81/166)	43.41 (79/182)	55.80† (101/181)	58.96† (102/173)	58.33† (91/156)

Compared with baseline *P<0.05; †P<0.01.

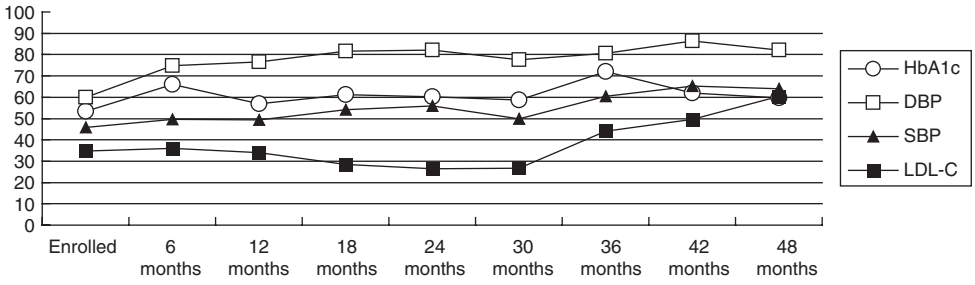

Fig. 1. Changes of standard rates of HbA1c, SBP, DBP, and LDL-C for 48 months.

Table 3. The optimal control rates of blood glucose, blood lipids, and blood pressure for 48 months (%)

Index	Optimal control rate	
Fasting blood glucose	52.17	96/184
2-h postprandial blood glucose	60.22	109/181
HbA1c	46.45	85/183
TG	53.01	97/183
TC	18.92	35/185
LDL-C	17.49	32/183
HDL-C	13.59	25/184
SBP	22.28	41/184
DBP	76.09	140/184
BP	19.13	35/183

The levels of SBP (125.04 mmHg) and DBP (71.73 mmHg) were reduced by 4 mmHg compared with 129.38 mmHg and 75.80 mmHg at baseline (P<0.01). The dynamic changes of blood glucose, blood lipids, and blood pressure for patients with diabetes for 48 months are shown in Table 5.

Discussion

According to the domestic and international literature involving elderly patients with diabetes, including patients with diabetes after 60 years of age, or patients with diabetes before 60 years of age and extending to >60 years of age, the number of elderly patients with diabetes was significantly greater than the number of non-elderly patients, and the number of elderly diabetics is increasing rapidly. Clinically, there are fewer pure patients with diabetes without other metabolic disorders [5]. Hypertension is the most common complication of the elderly with diabetes, and is also one of the main factors underlying cardio- and cerebro-vascular diseases. The threat of diabetes combined with hypertension is more serious for human health.

Ideal diabetes control is the long-term joint standard of blood glucose, blood lipids, and blood pressure. While the joint standard rate is not higher internationally [6], the standard rate of blood glucose for diabetes in Chinese cities is 10%–40% [7, 8]. The standard rate of blood lipids is lower (approximately 20%) [9] and the joint standard rate of the three indices is approximately 10% [10]. Through 48 months of management

Table 4. The joint standard rate of blood glucose, blood lipids, and blood pressure for patients with diabetes before and after 48 months % (n/N)

Category	Baseline	12 months	24 months	36 months	48 months
HbA1c+LDL-C	17.19	22.43	18.84	31.67†	40.00†
	33/192	24/107	26/138	38/120	36/90
HbA1c+BP	20.83	22.14	29.22	41.84†	41.75†
	40/192	31/140	45/154	59/141	43/103
HbA1c+LDL-C+BP	6.25	6.6	8.70	22.50†	24.72†
	12/192	7/106	12/138	27/120	22/89

Compared with baseline †P<0.01.

Table 5. The levels of blood glucose, blood lipids, and blood pressure for patients with diabetes for different months (x±s)

Index	Baseline	6 months	12 months	18 months	24 months	30 months	36 months	42 months	48 months
Fasting blood glucose	7.64±2.39	7.38±2.20	7.06±1.63*	7.04±1.74†	7.11±1.76*	7.20±2.13	6.90±1.45†	7.07±1.87*	6.94±1.80†
2-h postprandial blood glucose	10.44±4.07	9.09±2.39†	8.89±1.94†	8.98±2.73†	9.02±2.55†	9.12±2.43†	8.98±1.87†	8.88±1.77†	8.96±1.61†
HbA1c	7.06±1.48	6.73±1.11*	6.99±1.47	6.95±1.16	6.82±0.97*	6.95±1.17	6.88±1.06*	6.95±1.00	6.88±0.89*
TG	1.84±1.00	1.81±1.01	1.66±0.93	1.66±0.86*	1.54±0.77†	1.65±0.95*	1.63±0.92*	1.70±0.92	1.57±0.83*
TC	5.00±0.93	5.03±1.03	4.97±1.10	5.10±1.02	5.01±0.94	4.90±0.91	4.74±0.85*	4.87±0.88	4.71±0.86*
LDL-C	2.95±0.87	2.91±0.86	3.01±0.87	3.07±0.88*	3.04±0.77	2.99±0.86	2.63±0.68†	2.62±0.69†	2.55±0.71†
HDL-C	1.15±0.44	1.12±0.28	1.05±0.27	1.04±0.27†	1.01±0.22†	0.99±0.26†	0.98±0.22†	0.94±0.24†	0.92±0.20†
SBP	129.38±12.05	128.01±9.41	127.03±9.14*	127.46±8.44*	125.63±8.90†	127.18±7.65*	125.14±8.27†	125.15±7.09†	125.04±7.55†
DBP	75.80±7.93	73.69±6.39†	73.14±5.71†	72.27±6.34†	71.40±6.03†	72.38±6.43†	72.34±5.69†	71.65±5.60†	71.73±6.26†

Note: unit of blood glucose and blood lipids: mmol/L; unit of HbA1c: %; unit of blood pressure: mmHg.
Compared with baseline *$P<0.05$; †$P<0.01$.

in the current study, the joint standard rate of the three indices was clearly increased. Only one-fifth of patients reached the joint standard rate of the three indices and four-fifths of patients did not reach the standard and should be strengthened and managed by physicians of the Community. During control of diabetes, control of any one dangerous factor only cannot reduce the danger of cardio- and cerebro-vascular diseases by >50% [11]. Elderly patients with diabetes always have a long course and multiple complications, such as hypertension and dyslipidemia. Clinically, it is not easy for only one index to reach the standard and it is more difficult that the long-term joint standard rate of blood glucose, blood lipids, and blood pressure reaches the standard.

At the end of the observation period, the values of blood glucose, HbA1c, and blood pressure were gradually reduced, while the standard rate was gradually increased. Fasting blood glucose was reduced by <1 mmol/L and the standard rate was increased by 6.91%. The postprandial blood glucose was reduced by 1.48 mmol/L and the standard rate was increased by 24%. The HbA1c was reduced by <1% and the standard rate was increased by 5%. Fluctuation of blood glucose was related to retinopathy [12]. The importance of reducing HbA1c is emphasized in IDF, the diabetes treatment guidelines of China, and the diabetes treatment guidelines of the American Diabetes Association [13, 14]. Poorer control of blood lipids is the main factor which affects the joint standard rate. The standard rate of LDL-C in tertiary hospitals in China is not higher [15]. Managing physicians are required to strengthen blood lipid treatment from the 24th month. One year later, the level of LDL-C was reduced and the standard rate was the highest in the 48 months, and a little reduced later. Lipid regulation therapy for these patients attached importance to reducing the use of LDL-C and statins, which was greatly increased compared with the baseline, while the number of patients taking fibrates was very low. The level of HDL-C was continuously reduced and the standard rate of HDL-C was the lowest in other various indices, which was related to fewer drugs to increase the HDL-C clinically. Fibrates can improve the level of HDL-L; however, combined use of fibrates and statins does not reduce cardiovascular events [16]. New topics have been raised on how to improve HDL-C for physicians of the Community.

Optimal control rate means that the times of standard rate of an index during a period are not <75% of the total times. It is useful for physicians for judging the long-term management level of patients with chronic diseases. The higher the optimal control rate, the more stable the index. Through 48 months of dynamic observation, the optimal control rate of postprandial blood glucose was the highest, and the optimal control rate of blood lipids and blood pressure was lower. HbA1c reflected the average level of blood glucose in the past 2~3 months and had a high-positive correlation with fasting blood glucose [17], which may be one of the reasons that the optimal control rate of fasting blood glucose and HbA1c was lower than postprandial blood glucose. Due to atherosclerosis, the large pulse pressure difference and low DBP, the type of elderly hypertension is pure systolic hypertension. Because blood pressure is affected by the environment, mood, and other relevant factors, it is more difficult for SBP to reach the standard. The optimal control rate of SBP is low, resulting in a low optimal control rate of BP.

Weight management is an important content of diabetes management. Most patients with diabetes are combined with metabolic syndrome. With gradual drops of blood glucose and blood lipids, BMI has no obvious change and metabolic syndrome is also controlled, but it takes a long time to intervene for reaching the ideal level. Control of diabetes requires a long-term course and penetrates the entire life of patients. The control rate of a given time may be better, but it is hard to maintain for long.

Elderly patients with diabetes are always combined with other diseases. Of the patients investigated this time, >75% took more than 2 kinds of hypoglycemic drugs and >64% took more than 2 kinds of antihypertensive drugs. Patients adopted different methods for taking various drugs. Unlike anti-hypertensive drugs, there are fewer slow- and controlled-release formulations of hypoglycemic drugs. Most hypoglycemic drugs must be taken three to four times a day. Elderly patients may easily forget. These are the causes of non-ideal control of blood glucose. Insisting on standardized management, various indices will reach ideal levels through control for a longer time.

Conflict of interest

The authors declare no conflict of interest.

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