Original Article

Vascular Complications of Type 2 Diabetes Mellitus among Elderly: Study at a Tertiary Health Care Centre in the Sub-Himalayan Region

Rahul Gupta*, Rajesh Bhawani, Surinder Thakur***, Jatinder Kumar Mokta****, Anjali Mahajan#**

Abstract

Objective: To study the frequency of macrovascular and microvascular complications in elderly with type 2 diabetes mellitus and its correlation with major cardiovascular risk factors.

Research Design and Methods: 64 patients attending outpatient clinic who fulfilled the inclusion criteria of age more than 60 years with type 2 diabetes were studied during one year. Vascular complications and their risk factors were identified using a standardized questionnaire, blood and urine analysis.

Results: The mean age of the patients was 67.62 ± 5.05 years. Middle age onset diabetes was seen in 43.75% of the study group, while 56.25% had elderly onset diabetes. The most prevalent cardiovascular risk factor was dyslipidemia (75.00%) followed by hypertension (71.87%), smoking (37.50%) and obesity (34.37%). Coronary artery disease, cerebrovascular disease and peripheral vascular disease were seen in 17.19%, 17.19% and 12.50% respectively, while diabetic retinopathy, diabetic nephropathy and neuropathy was seen in 31.25%, 25.00% and 28.13% respectively. 45.31% had no vascular complications. As compared to elderly onset diabetes those with middle age onset diabetes had higher mean HbA_1C levels(8.94% vs 7.96%) and more prevalence of obesity (42.86% vs 27.78%), dyslipidemia (85.71% vs 66.67%), macro vascular (39.29% vs 25.00%) and micro vascular complications (50.00% vs 33.33%).

Conclusion: The longer duration of diabetes and presence of multiple cardiovascular risk factors in elderly with type 2 diabetes mellitus makes them susceptible to vascular complications thereby increasing morbidity and mortality. Moreover, middle age and elderly onset diabetes appear to be two distinct groups with a difference in burden of cardiovascular risk factors and vascular complications. Future studies of diabetes in elderly may need to consider such difference while defining the treatment goals for this group.

Key words: Type 2 diabetes, elderly, vascular complications

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INTRODUCTION

The global incidence of type 2 diabetes mellitus (DM) continues to grow at an alarming rate. Current projections estimate that the numbers of people with DM will nearly double by 2025.[1] A significant proportion of these people with diabetes are elderly, and the prevalence of diabetes is more

*Resident, **Associate Professor, Department of Medicine,***Professor and Head, Department of Medicine, **** Professor, Department of Medicine; #Assistant Professor, Department of Community Medicine, Indira Gandhi Medical College, Shimla (H.P.)

Corresponding Author: Rahul Gupta, Department of Medicine, IGMC, Shimla-171001 E-mail: rahulmed1602@gmail.com

than two times higher among elderly adults compared to middle aged or young adults. The National Health Survey data demonstrated the rising prevalence of diabetes in the older population over time. The prevalence of diabetes for age 65–79 years per 1000 population was 6.0 in 1990, 11.6 in 2000, and 12.4 in 2010.[2] In the population based studies conducted by Meneily et al, Ramachandran et al, Gupta et al and Singh et al the prevalence of diabetes among elderly in India was 20%, 18.8%, 11% and 17.75% respectively.[3-6] Elderly with type 2 diabetes have vascular complications in excess to those without diabetes, and that contributes to a substantial burden on the healthcare system. The present study was aimed at evaluating the profile of vascular complications in elderly with type 2 diabetes in the sub-Himalayan region.

MATERIALS AND METHODS

This study was an observational cross sectional study carried out on elderly with type 2 diabetes mellitus attending the diabetic clinic at a tertiary health care centre for one year. A detailed informed consent was taken from all participants.

Assessment of diabetes

Elderly of 60 years and above were included in this study, and diabetes was defined according to the American Diabetes Association guidelines. Elderly individuals with diabetes diagnosed in their middle age (<60 years) were classified as having middle-age-onset diabetes, and those with diabetes diagnosed at age ≥60 years were classified as having elderly-onset diabetes.[7,8]

Assessment of cardiovascular risk factors

Hypertension was defined as SBP≥140 mm Hg and/or DBP ≥90 mm Hg or a history of hypertension. Dyslipidemia was defined as per the NCEP-ATPIII guidelines. Smoking and alcohol consumption were defined according to the US Centres for disease control and prevention definitions. Obesity was labelled according to the Indian Consensus Guidelines of Obesity: normal-18-22.9 kg/m^2, overweight: 23-24.9 kg/m^2 and obese: >25kg/m^2.

Assessment of vascular complications

Coronary artery disease (CAD) was defined by the presence of any one of the following: documented acute MI based on history of chest pain, ECG changes and elevated levels of markers of myocardial necrosis, history of CABG/PTCA, history of chest pain with inducible ischemia on stress test, ECG evidence of silent myocardial infarction identified by Minnesota code 1:1,1:2 or ECG evidence of LBBB with regional wall motion abnormality on 2D echocardiography. Cerebrovascular disease(CVD) was defined as a history of transient ischemic attack or focal deficit or stroke on CT scan. Peripheral vascular disease(PVD) was defined as a history of claudication or rest pain associated with feeble or absent peripheral pulses or an ankle brachial index <0.9.

Retinopathy was classified according to modified ETDRS (Early Treatment Diabetic Retinopathy Study) criteria into proliferative and non-proliferative subtypes. Diabetic nephropathy was defined in our study by the presence of micro-albuminuria or macroalbuminuria and/ or eGFR less than 60 ml/min. Diabetic neuropathy was defined as symptoms or signs of loss of vibratory/ light touch sensation or reduced / absent ankle reflexes.

In addition, following laboratory investigations were done: fasting and post-prandial blood sugar, fasting lipid profile, serum urea, serum creatinine, HbA_1C, spot urine albumin / creatinine ratio and ECG.

Statistical analysis

Data were recorded on a Microsoft Excel spreadsheet. Statistical analysis was performed using Epi Info version 7.2.0.1 and SPSS student version 16.0 (SPSS Inc, Chicago, USA). All discrete variables were expressed as percentages. The differences in the distribution of discrete variables were analysed using Pearson Chi square test or Fischer's exact test, whichever was applicable. The significance of the difference in continuous variables was analysed by student t test. The P value of <0.05 was considered as statistically significant.

RESULTS

Baseline characteristics

The baseline clinical characteristics of the patients are presented in Table 1. A total of 64 patients were included in our study. The mean age of patients was 67.62 ± 5.05 years. A maximum number of patients were in the age group of 60-70 years, i.e., 44 (68.75%) followed by 70-80 years. Middle age onset diabetes was seen in 43.75% of the study group, while 56.25% had elderly onset diabetes.

Baseline biochemical characteristics

Baseline biochemical characteristics of elderly with type 2 diabetes mellitus are presented in Table 2.

Prevalence of risk factors for vascular complications

The prevalence of risk factors for vascular complications in elderly with type 2 diabetes mellitus is presented in Table 3. 50.01% had three or more risk factors, on the other hand, 3.13% had no risk factors. The commonest risk factor was dyslipidemia (75.00%) followed by hypertension (71.87%), smoking (37.50%) and obesity (34.37%). Among those with dyslipidemia, 22 (34.38%) had total cholesterol ≥ 200 mg/dl, 31 (48.44%) had LDL ≥ 100 mg/dl, 17 (26.56%) had HDL ≤ 40 mg/dl and 31 (48.44%) had triglyceride ≥ 150 mg/dl.

Prevalence of vascular complications

Among 64 patients in our study, 54.69% had vascular complications. Macro vascular complication(s) were seen in 20(31.25%), while micro vascular complication(s) were present in 26 (40.63%). Both macro and micro vascular complications were seen in 11(17.19%) patients, while 29 (45.31%) had none. CAD, CVD and PVD were seen in 17.19%, 17.19% and 12.50% respectively, while retinopathy, diabetic nephropathy and neuropathy was seen in 31.25%, 25.00% and 28.13% respectively (Table 4).

Clinical and biochemical characteristics in middle age onset and elderly onset diabetes

The clinical and biochemical characteristics of middle age onset and elderly onset type 2 diabetes are presented in Table 5. Compared to elderly onset diabetes those with middle age onset diabetes had longer duration of diabetes (11.0 vs 2.63 years), higher mean HbA1c (8.94% vs 7.96%) and more prevalence of obesity (42.86% vs 27.78%), dyslipidemia (85.71% vs 66.67), macro vascular (39.29% vs 25.00%) and microvascular complications (50.00% vs. 33.33%).

DISCUSSION

Elderly with type 2 diabetes are a subset of patients with unique clinical and biochemical abnormalities. The vascular complications of diabetes are a major cause of morbidity and mortality in elderly, and this group may be at a disproportionately increased risk of vascular complications due to their longer duration of disease and clustering of cardiovascular risk factors. This clustering of cardiovascular risk factors was shown in our study with 50.01% of the study group having three or more cardiovascular risk factors.

Among the cardiovascular risk factors, dyslipidemia was most prevalent and was seen in 48 (75.00%) patients. Among those with dyslipidemia, hypertriglyceridemia (48.44%) was more prevalent than either elevated total cholesterol or low-density lipoprotein. Our finding was corroborated by those of Singh et al. and Chew et al. where 42% and 41.2% respectively had elevated triglycerides levels.[9,10] The dyslipidemia pattern of elevated triglyceride and low HDL is characteristic of type 2 diabetes and contributes to accelerated atherosclerosis.[11] Hypertension is a common co morbidity among elderly and can be seen in up to 80% of those aged 60 years and above.[12] Coexistence of diabetes and hypertension serves to exacerbate each other and up to 75% of cardiovascular disease in diabetes may be attributable to hypertension.[13] Hypertension was noted in 71.68% of the elderly diabetics in our study and our finding corroborated with those by Selvin et al., Motta et al., Bourdel-Marchasson et al., and Suh et al. where hypertension was seen in 80%,75%, 83.9% and 83% respectively.[8,14-16] Obesity is a major risk factor for type 2 diabetes mellitus but when present along with diabetes it puts an individual at higher risk for cardiovascular disease.[17] In our study 34.38% were obese, and this was similar to those by Sazlina et al., Hewitt et al. and Puria et al.[18-20] Smoking is another risk factor for vascular complications of diabetes mellitus. In micro vascular complications, the onset and progression of diabetic nephropathy are highly associated with smoking, while in macro vascular complications, smoking is associated with a two to three times higher incidence of CHD and mortality.[5] In our study, smoking was seen in 37.50% of the study group. It was 57.43% in the study by Hewitt et al[19], whereas it was 84% in that of Araki et al[21]. In our opinion, this variability in the prevalence of smoking may be due to the differences in sociocultural practices, education, regional policies, gender equality and economic status.

Excess mortality in type 2 diabetes is caused by vascular complications, and in our study, 31.25% and 40.63% were having macro and micro vascular complications respectively. Among macro vascular diseases, coronary artery disease (CAD) and cerebrovascular disease (CVD) contributed

substantially to excess mortality and was seen in 17.19% each in our study. Our finding was similar to the studies by Singh et al, Araki et al, and Lee et al.[9,21,22] Diabetes is the leading cause of non-traumatic lower extremity amputations, and peripheral vascular disease is a major contributor to this. In our study, PVD was seen in 12.50% of the elderly diabetics. Our finding was corroborated with those by Selvin et al, Suh et al, and Sazlina et al where it was seen in 18.4%, 10.5%, and 14.2% respectively.[8,16,18]

Table 1: Baseline characteristics of elderly with Type 2 diabetes mellitus

Variable	Group	Total (n=64) n (%)	Male (n=37) n (%)	Female (n=27) n (%)	p Value
Age (years)	60-70	44(68.75%)	25(39.06%)	19(29.68%)	
	71-80	18(28.13%)	11(17.18%)	7(10.93%)	0.929
	>80	2(3.13%)	1(1.56%)	1(1.56%)	
Sex		64(100%)	37(57.81%)	27(42.19%)	0.06
Habitat	Rural	31(48.44)	17(45.95%)	14(51.85%)	0.54
	Urban	33(51.56)	20(54.05%)	13(48.15%)	
Age of diagnosis	<60years	28(43.75%)	16(43.24%)	12(44.44%)	0.62
	>60years	36(56.25%)	21(56.76%)	15(55.56%)	

Table 2: Baseline biochemical characteristics in elderly Type 2 diabetes mellitus (n=64)

Variable	Total (n=64)	Male (n=37)	Female (n=27)	p Value
FBS (mg/dl)	154.18±47.742	149.78±47.99	160.22±47.63	0.392
PPBS (mg/dl)	238.54±66.08	238.43±72.78	238.70±56.98	0.987
HbA_1C (%)	8.39±2.1	8.46±1.91	8.29±2.37	0.741
Total cholesterol (mg/dl)	191.81±46.90	184.91±52.47	201.25±41.79	0.171
LDL (mg/dl)	103.01±31.11	100.24±31.16	106.81±31.23	0.408
HDL (mg/dl)	43.78±6.77	42.91±6.51	44.96±7.06	0.236
Triglycerides (mg/dl)	168.06±64.04	162.02±55.98	162.02±55.98	0.382
Blood urea (mg/dl)	31.18±16.54	31.43±12.26	30.85±21.31	0.891
Serum creatinine (mg/dl)	1.06±0.34	1.09±0.32	1.03±0.37	0.487

Table 3: Prevalence of Risk Factors for Vascular Complications in Elderly with Type 2 Diabetes

Risk Factors	Total (n=64) n(%)
Smoking	24(37.50)
Obesity	22(34.37)
Hypertension	46(71.87)
Dyslipidemia	48(75.00)

Table 4: Prevalence of vascular complications in elderly with Type 2 diabetes mellitus

Complication(s)	n(%) (n=64)
CAD	11(17.19)
CVD	11(17.19)
PVD	8(12.50)
Retinopathy	20(31.25)
Diabetic Nephropathy	16(25.00)
Neuropathy	18(28.13)

Table 5: Clinical and biochemical characteristics in middle age onset and elderly onset diabetes mellitus

Characteristics	Age of Onset <60 Years (n=28)	Age of Onset > 60 Years (n=36)	P - Value
Age (years)	64.14±3.17	70.33±4.57	0.049
Obesity (n)	12(42.86%)	10(27.78%)	0.208
Dyslipidemia (n)	24(85.71%)	24(66.67%)	0.081
Hypertension (n)	19(67.86%)	27(75.00%)	0.528
Smoking (n)	7(25.00%)	17(47.22%)	0.069
BMI ($kg/m^{2)}$	25.21±4.40	24.31±3.49	0.364
HbA_1C (%)	8.94±2.67	7.96±1.41	0.08
CAD (n)	7(25.00%)	4(11.11%)	0.18
CVD (n)	6(21.43%)	5(13.89%)	0.513
PVD (n)	6(21.43%)	2(5.56%)	0.124
Retinopathy (n)	11(39.29%)	9(25.00%)	0.28
Diabetic Nephropathy (n)	11(39.29%)	5(13.89%)	0.02
Neuropathy (n)	10(35.71%)	8(22.22%)	0.234

Disease of small blood vessels is the specific complication of diabetes and is termed diabetic microangiopathy. It contributes to mortality through renal failure caused by diabetic nephropathy, blindness from diabetic retinopathy, and difficulty in walking and chronic ulceration of feet from peripheral neuropathy. Among these microvascular complications, diabetic retinopathy was most prevalent in our study and was seen in 31.25%. Our finding was corroborated by those of Lee et al and Sinclair et al where it was seen in 42.2% and 40% respectively.[22,23] For adults older than 60 years of age, the leading cause of CKD and end stage renal disease is diabetic nephropathy. In our study, the prevalence of diabetic nephropathy in elderly type 2 diabetics was 25.00%. In the study by Araki et al, it was 49%, while it was 14.9% and 17.8% in the study by Chew et al and Sazlina et al respectively.[10,18,21] This variable prevalence is due to different criteria used for labelling patients with diabetic nephropathy. Araki et al reported microalbuminuria or persistent proteinuria, while Sazlina et al reported microalbuminuria, proteinuria, serum creatinine > 150 mmol/L or estimated glomerular filtration rate < 60 mls/min (Cockroft-Gault formula) for defining diabetic nephropathy.[18,21] In our study, we had included micro albuminuria, macro albuminuria and estimated eGFR<60ml/min for defining diabetic nephropathy. Distal sensorimotor polyneuropathy is one of the long term complications of diabetes and patients with diabetic peripheral neuropathy (DPN) are at increased risk of falling. In our study the prevalence of neuropathy was 28.13% while in hospital based studies by Selvin et al. and Singh et al. it was 35.5% and 52% respectively.[8,9] The varied prevalence of neuropathy may be due to differences in the criteria used for labelling patients with diabetic neuropathy. While Selvin et al used clinical examination to detect neuropathy, Singh et al used nerve conduction studies along with the evaluation of autonomic neuropathy for diagnosing diabetic neuropathy.[8,9]

We also did a subgroup analysis comparing elderly individuals with middle age onset diabetes mellitus (diabetes diagnosed at less than 60 years of age) and elderly onset diabetes mellitus (those diagnosed after the age of 60 years). Literature regarding the comparison of middle age onset type 2 diabetes with elderly onset diabetes in India is limited, and most of the studies have been conducted abroad.

In our study, 43.75% had a diagnosis of diabetes before 60 years of age while it was 58.40% and 31.1% in the study by Selvin et al. and Bong-Ki Lee et al. respectively.[8,22] This variability may be due to regional differences in health awareness and screening policies. The mean HbA_1C levels were higher in those with middle age onset diabetes (8.94% vs. 7.96%) and was similar to the studies by Selvin et al and Lee et al.[8,22] Also in our study, both macro vascular and microvascular complications were more prevalent in those with middle age onset diabetes (39.29% vs. 25.00% and 50.00% vs. 33.33%, respectively). This was in contrary to the studies by Selvin et al. and Lee et al. where the prevalence of CAD and CVD were similar in the both the groups

and among microvascular complications diabetic retinopathy was more prevalent in those with middle age onset diabetes.[8,22] The higher prevalence of vascular complications in middle age onset diabetes can be due to longer duration of diabetes, higher mean HbA_1C levels and higher prevalence of obesity (42.86% vs. 27.78%) and dyslipidemia (85.71% vs. 66.67%) in this group.

In our study, we have documented a substantial burden of cardiovascular risk factors and vascular complications among elderly diabetics. Due to the clustering of cardiovascular risk factors, most of them will require multiple drugs for their control. However, this is often limited by the co-existing co-morbidities and frequent side effects of drugs in the elderly. We also showed that middle age onset and elderly onset diabetes appears to be two distinct groups with the different burden of cardiovascular risk factors and vascular complications. The higher prevalence of vascular complications in middle age onset diabetes may warrant more aggressive control of cardiovascular risk factors and strict glycemic control in this group. On the other hand, elderly onset diabetes who are less likely to have vascular complications and often have other competing causes of mortality may require an individualized approach to the treatment of diabetes and cardiovascular risk factors.

Although it is clear that this older population with diabetes is at risk for traditional vascular complications more data and rigorous studies are needed to characterize the natural history of diabetes in elderly, to assess the effect of glycemic control and to define the differences between elderly onset and middle age onset diabetes.

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