Patients with diabetes mellitus with ischemic stroke have a higher hemoglobin A_{1c} level and a higher serum low-density lipoprotein cholesterol level than diabetics without ischemic stroke

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Submitted: 15 August 2008
Accepted: 16 September 2008

Arch Med Sci 2009; 5, 3: 391-393

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Abstract

Introduction: To investigate the association between the hemoglobin A_{1c} level and the serum low-density lipoprotein (LDL) level in diabetics with and without ischemic stroke.

Material and methods: The patient population included 408 diabetics, mean age 66 years, with ischemic stroke and 404 age-matched and gender matched diabetics without ischemic stroke. The prevalence of race, hypertension, use of statins, current smoking, obesity, carotid arterial disease, obstructive coronary artery disease, prosthetic valve, and atrial fibrillation was not significantly different between diabetics with and without ischemic stroke.

Results: The hemoglobin A_{1c} level was < 7.0% in 141 of 408 diabetics (35%) with stroke and in 221 of 404 diabetics (55%) without stroke ($p < 0.001$). The serum low-density lipoprotein (LDL) cholesterol was < 100 mg/dl in 164 of 408 diabetics (40%) with stroke and in 269 of 404 diabetics (67%) without stroke ($p < 0.001$). The serum LDL cholesterol was < 70 mg/dl in 34 of 408 diabetics (8%) with stroke and in 127 of 404 diabetics (31%) without stroke ($p < 0.001$).

Conclusions: Diabetics should have their hemoglobin A_{1c} level reduced to < 7.0% and their serum LDL cholesterol reduced to < 70 mg/dl.

Key words: diabetes mellitus, ischemic stroke, hemoglobin A_{1c}, serum low-density lipoprotein cholesterol.

Introduction

Diabetes mellitus is a major risk factor for ischemic stroke [1, 2]. The hemoglobin A_{1c} level in patients with diabetes mellitus should be reduced to < 7.0% to reduce the incidence of ischemic stroke [3, 4]. Patients with diabetes mellitus should also be treated with statins to reduce the serum low-density lipoprotein (LDL) cholesterol level to < 70 mg/dl to reduce the incidence of ischemic stroke [3, 5-9]. The present study reports the prevalence of risk factors for ischemic stroke in 408 patients with diabetes mellitus and ischemic stroke and in 404 age-matched and gender-matched patients with diabetes mellitus without ischemic stroke. The present study also investigated whether diabetics with a hemoglobin A_{1c} level < 7.0% and a serum LDL cholesterol < 70 mg/dl had a lower prevalence of ischemic stroke than diabetics with a hemoglobin A_{1c} level

> 7.0% and a serum LDL cholesterol > 70 and > 100 mg/dl.

Material and methods

The patients included 408 consecutive patients (218 men and 190 women), mean age 66 ±8 years, with diabetes mellitus and ischemic stroke and 404 consecutive age-matched and gender-matched patients with diabetes mellitus without ischemic stroke. There were no exclusion criteria. Ischemic stroke was diagnosed in all patients by a neurologist and confirmed by magnetic resonance imaging or brain computed tomography in all patients. Obstructive coronary artery disease was diagnosed in all patients if there was greater than 50% obstruction of at least 1 major coronary artery [10-12]. Blood samples for hemoglobin A_{1c} levels and serum LDL cholesterol levels were drawn within 1 month prior to the ischemic stroke. The study duration was 2 years.

Table I. Baseline characteristics of patients with diabetes mellitus with and without ischemic stroke

Variable	Diabetes with stroke (n = 408)	Diabetes without stroke (n = 404)
Age [years]	66 ±8	66 ±8
Men	218 (53%)	211 (52%)
Women	190 (47%)	193 (48%)
Whites	346 (85%)	343 (85%)
Nonwhites	62 (15%)	61 (15%)
Hypertension	367 (90%)	360 (89%)
Current smoker	74 (18%)	78 (19%)
On statin	370 (91%)	375 (93%)
Body mass index ≥ 30 kg/m^2	66 (16%)	62 (15%)

None of the differences are significant

Table II. Prevalence of carotid arterial disease, prosthetic valve, and atrial fibrillation in patients with and without ischemic stroke

Variable	Diabetes with stroke (n = 408)	Diabetes without stroke (n = 404)
Carotid arterial disease	36 (9%)	25 (6%)
Obstructive CAD	34 (8%)	31 (8%)
Prosthetic valve	21 (5%)	18 (4%)
Atrial fibrillation	47 (12%)	44 (11%)

None of the differences are significant
CAD – coronary artery disease

Table III. Prevalence of a hemoglobin A_{1c} < 7.0% and of a serum low-density lipoprotein cholesterol < 100 and < 70 mg/dl in patients with diabetes mellitus with and without ischemic stroke

Variable	Diabetes with stroke (n = 408)	Diabetes without stroke (n = 404)	p value
Hemoglobin A_{1c} < 7.0%	141 (35%)	221 (55%)	< 0.001
Serum LDL cholesterol < 100 mg/dl	164 (40%)	269 (67%)	< 0.001
Serum LDL cholesterol < 70 mg/dl	34 (8%)	127 (31%)	< 0.001

LDL – low-density lipoprotein

The prevalence of whites and nonwhites, hypertension, current smoking, use of statins, body mass index ≥ 30 kg/m^2, carotid arterial disease, obstructive coronary artery disease, prosthetic valve, atrial fibrillation, hemoglobin A_{1c} < 7.0%, serum LDL cholesterol < 100 mg/dl, and serum LDL cholesterol < 70 mg/dl was investigated in the patients with diabetes mellitus with ischemic stroke and without ischemic stroke.

Student's t tests were used to analyze continuous variables. Chi-square tests were used to analyze dichotomous variables. Multivariate analysis was also performed.

This study was approved by the Institutional Review Board of New York Medical College.

Results

Table I shows the baseline characteristics of the patients with diabetes mellitus with and without ischemic stroke. No significant differences are present. Table II shows the prevalence of carotid arterial disease, obstructive coronary artery disease, prosthetic valve, and atrial fibrillation in the patients with diabetes mellitus with and without ischemic stroke. No significant differences are found.

Table III shows the prevalence of a hemoglobin A_{1c} level < 7.0%, of a serum LDL cholesterol level < 100 mg/dl, and of a serum LDL cholesterol level < 70 mg/dl in the patients with diabetes mellitus with and without ischemic stroke. Table III also lists levels of statistical significance between the 2 groups. Multivariate analysis showed that a hemoglobin A_{1c} level < 7.0%, of a serum LDL cholesterol level < 100 mg/dl, and of a serum LDL cholesterol level < 70 mg/dl were significant independent predictors of a reduced prevalence of ischemic stroke in the patients with diabetes mellitus (p < 0.001). These results were not affected by the use of cardiovascular drugs other than statins.

Discussion

An elevated hemoglobin A_{1c} level is a risk factor for ischemic stroke [3, 4] and for coronary artery disease [3, 13]. The American Diabetes Association

recommends reducing the hemoglobin A_{1c} level in patients with diabetes mellitus to < 7.0% to reduce ischemic stroke and coronary events [3].

In the Atherosclerosis Risk in Communities (ARIC) Study, compared with adult diabetics in the lowest tertile of hemoglobin A_{1c}, adult diabetics in the highest tertile of hemoglobin A_{1c} had a 4.7 times significant increase in adjusted risk of stroke [4]. In the present study, the prevalence of a hemoglobin A_{1c} level < 7.0% was significantly higher in patients with diabetes mellitus without ischemic stroke (55%) than in diabetics with ischemic stroke (35%) ($p < 0.001$).

Statins have been demonstrated to reduce ischemic stroke in patients with diabetes mellitus [6-9] and are recommended for the treatment of patients with diabetes mellitus [3, 5]. The lower the serum LDL cholesterol level achieved by statins, the greater the reduction in ischemic stroke [6-9].

In the present study, the prevalence of use of statins was similar in patients with diabetes mellitus with ischemic stroke (91%) and without ischemic stroke (93%). However, the prevalence of a serum LDL cholesterol < 100 mg/dl was 67% in the patients with diabetes mellitus without ischemic stroke and 40% in the diabetics with ischemic stroke ($p < 0.001$). The prevalence of a serum LDL cholesterol < 70 mg/dl was 31% in the patients with diabetes mellitus without ischemic stroke and 8% in the diabetics with ischemic stroke ($p < 0.001$). These data support reducing the serum LDL cholesterol with statins to < 70 mg/dl to decrease the incidence of ischemic stroke. The weakness of this study is that it was an observational study and not a randomized double-blind, placebo-controlled study.

In conclusion, the data from this observational study support reducing the hemoglobin A_{1c} level in patients with diabetes mellitus to < 7.0% to reduce the incidence of ischemic stroke [3, 4] and support reducing the serum LDL cholesterol level to < 70 mg/dl to reduce the incidence of ischemic stroke [3, 5-9].

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