Goal Achievement of Low-Density Lipoprotein Cholesterol Levels in Patients with Ischemic Stroke and Hyperlipidemia at Prasat Neurological Institute

นิพนธ์ต้นฉบับ

Original Article

เสริมสุข ละอองสุวรรณ*, ธนวดี ช.สรพงษ์ , ขวัญชัย บุญรักชัย และ กุสุมา แจ่มศักดิ์

กลุ่มงานเภสัชกรรม สถาบันประสาทวิทยา 312 ถนนราชวิถี แขวงทุ่งพญาไท เขตราชเทวี กรุงเทพ 10260

* **ติดต่อผู้นิพนธ์:** sermsook201@hotmail.com

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Sermsook La-ongsuwan*, Tanawadee Chor. Soraphong, Kwanchai Bunrukchai and Kusuma Jaemsuk

Department of Pharmacy, Prasat Neurological Institute, 312 Rachatavee Road , Tungprayathai , Rachatavee , Bangkok , Thailand 10260

* **Corresponding author:** sermsook201@hotmail.com

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บทคัดย่อ

วัตถุประสงค์: เพื่อศึกษาอัตราการบรรลุเป้าหมายระดับไขมันในเลือดชนิดแอลดีแอล (LDL-C) ในผู้ป่วยโรคหลอดเลือดสมองแบบตีบที่มีภาวะไขมันในเลือดสูงของสถาบันประสาทวิทยา และการเกิดอาการไม่พึงประสงค์แบบ myalgia และ rhabdomyolysis จากการใช้ยากลุ่มสเตติน **วิธีการศึกษา:** การศึกษาเชิงพรรณนาแบบย้อนหลัง ศึกษาที่หอผู้ป่วยโรคหลอดเลือดสมอง ในช่วงมีนาคมถึงพฤศจิกายน พ.ศ. 2554 บันทึกข้อมูลและค่าระดับไขมันในเลือดจากเวชระเบียนเมื่อผู้ป่วยเข้ารับการรักษาในหอผู้ป่วยและติดตามค่าดังกล่าวอีกครั้งเมื่อผู้ป่วยมารับการติดตามรักษาในช่วงเวลา 1 ปี **ผลการศึกษา:** ศึกษาผู้ป่วยทั้งสิ้น 197 คนที่เข้ารับการรักษาที่หน่วยโรคหลอดเลือดสมองตีบ โดยแบ่งเป็น 4 กลุ่ม กลุ่มเอ (ไม่เป็นโรคเบาหวานและไม่เคยได้รับยาสเตติน) กลุ่มบี (ไม่เป็นโรคเบาหวานและเคยได้รับยาสเตติน) กลุ่มซี (เป็นโรคเบาหวานและไม่เคยได้รับยากลุ่มสเตติน) กลุ่มดี (เป็นโรคเบาหวานและเคยได้รับยาสเตติน) อัตราการบรรลุเป้าหมายระดับ LDL-C เป็น 82.22%, 68.89%, 21.74% และ 37.04% ในกลุ่มเอ, บี, ซี และดีตามลำดับ พบว่าใช้ simvastatin มากที่สุด (89.34%) ขนาดยาอยู่ระหว่าง 10 – 40 มก./วัน ไม่พบอาการ myalgia และ rhabdomyolysis **สรุป:** ผู้ป่วยโรคหลอดเลือดสมองแบบตีบที่มีภาวะไขมันในเลือดสูงและมีโรคเบาหวานมีอัตราบรรลุเป้าหมายของระดับ LDL-C ค่อนข้างต่ำเมื่อเทียบกับกลุ่มที่ไม่มีโรคเบาหวาน ผู้ป่วยส่วนใหญ่ได้รับยาสเตตินที่มีความแรงต่ำ และไม่พบอาการข้างเคียงจากยาสเตติน

คำสำคัญ: การบรรลุเป้าหมาย, โรคหลอดเลือดสมองแบบตีบ, ไขมันชนิดแอลดีแอล, สเตติน

Abstract

Objective: To determine the goal achievement rate of LDL-C in patients with ischemic stroke and hyperlipidemia at Prasat Neurological Institute (PNI) and incidence of adverse effects of statins namely myalgia and rhabdomyolysis. **Method:** With descriptive and retrospective design, patients with ischemic stroke and hyperlipidemia admitted in the stroke unit at PNI during March to September 2011 were studied by chart review. Lipid profile levels at admission and within 1 year after discharge were recorded. **Results:** A total of 197 patients admitted stroke unit during March to November 2011. Four groups of patients were classified: patients with no diabetes and no statin use (group A), no diabetes with statin use (group B), diabetes patients with no statin use (group C), and diabetes patients with statin use (group D). LDL-goal achievement rates were 82.22%, 68.89%, 21.74%, and 37.04% in groups A, B, C and D, respectively. Simvastatin was the most prescribed lipid lowering agent (89.34%) with a dose range of 10 to 40 mg per day. No myalgia or rhabdomyolysis was found. **Conclusions:** Low rates of LDL-goal achievement were found in diabetic patients with ischemic stroke and hyperlipidemia. Most patients were on simvastatin and no adverse effects of statin were found.

Keywords: goal achievement, ischemic stroke , LDL–C, statins

Introduction

Hyperlipidemia is a healthcare problem in Thai population and one of the important risk factors in coronary heart disease, ischemic heart disease, acute myocardial infarction, peripheral arterial disease, and cerebrovascular disease. Stroke is a major cause of mortality and morbidity in Thailand. The data from the cause of death in 1990 revealed that stroke was a major cause of death in female and a third of death in male Thai people.[1] Moreover, this rate also increases every year in Thailand. Stroke is also a leading cause of functional impairments, with 20% of survivors requiring institutional care after 3 months and 15% to 30% being permanently disabled. Prevalence of stroke in Thailand is 690 : 100,000 population , approximately almost 500,000 stroke patients per 72 millions of Thai people.[2]

Large epidemiology studies in ischemic stroke have shown a modest association of elevated total cholesterol or low-density lipoprotein cholesterol (LDL-C) with the increased risk of ischemic stroke and the relationship between low LDL-C and the greater risk of intracerebral hemorrhage.[3]

The use of 3-hydroxy-3-methyglutaryl coenzyme A reductase inhibitors (statins) has been approved by regulatory agencies for prevention of ischemic stroke in patients with coronary heart disease (CHD). Statins therapy with intensive lipid-lowering effects is recommended for patients with atherosclerotic ischemic stroke or transient ischemic attack (TIA) and without known CHD to reduce the risk of stroke and cardiovascular events.[4] For those patients with atherosclerotic ischemic stroke or TIA and history of

CHD, it is recommended that clinicians follow the current 2011 the American Heart Association/American Stroke Association (AHA/ASA) guidelines[5] for lipid management, which emphasize utilization of National Cholesterol Education Panel III guidelines (NCEP III).[6]

Prasat Neurological Institute (PNI), an excellence center for the advancement in stroke research and treatment in Thailand, has been providing care for a total of 22,000 out-patients and 1,000 in-patients with cerebrovascular diseases annually, based on data from 2008 to 2010. Multidisciplinary team and also clinical pharmacist have been working in the stroke unit since 2010. According to the concept of aggressive reduction in cholesterol level, we undertook retrospective charts review to determine the goal achievement of LDL-C levels in patients with ischemic stroke and hyperlipidemia and prevalence of adverse drug reactions including myalgia and rhabdomyolysis in these patients.

Methods

A cross-sectional descriptive design was employed in this study. The study was conducted at the inpatient department (IPD) of the Stroke Unit at Prasat Neurological Institute, Bangkok, Thailand, during March to November 2011. This institution is under the Department of Medical Services, Ministry of Public Health, Thailand.

Sample in this study was ischemic stroke patients with hyperlipidemia admitted in the Stroke Unit, Prasat Neurological Institute during March to November 2011. The inclusion criteria were as follows: patients who received statin drug before or during admission and their baseline LDL-C level were recorded before hospital discharge. The exclusion criteria included patients with diagnosis of cardioembolic stroke or loss of contact after hospital discharge.

Data collection procedure

Demographic data including age, gender, underlying diseases, drug allergy history, smoking and alcohol use history were obtained from medical chart. Data regarding general, medical and family history were recorded at the Stroke Unit during admission by patient interview and medical chart review. All related laboratory tests including lipid profiles, liver function tests (AST, ALT), creatine kinase, fasting blood sugar and HbA1C levels were obtained during admission. The first laboratory tests and any adverse drug reactions including myalgia and rhabdomyolysis within one year after discharge from the Stroke Unit were recorded by medical chart review. For these laboratory test and adverse drug reactions data to be eligible, the patients had to be taking the same statin dose as the one during admission. Patients were classified into 4 groups according to their diabetes mellitus (DM) diagnosis and statin use before admission; patients with no DM and no statin use before admission (group A), patients with no DM and with statin use before admission (group B), patients with DM and no statin use before admission (group C), and patients with DM and statin use before admission (group D). Their LDL goal achievements based on the follow-up measures were set according to their DM status: < 100 mg/dL for those with no DM (groups A and B) and < 70 mg/dL for those with DM (groups C and D).

This study was approved by the Institutional Review Board and Independent Ethics Committee of the Prasat Neurological Institute (approval number: 2.205/2554; approval date: December 3, 2010).

Data Analysis

Descriptive statistics including frequency, percentage, range, mean, and standard deviation were used to describe demographic data, laboratory data at admission and follow up, mean LDL-C and goal achievement of LDL-C level. Paired t–test was used to compare means of laboratory data and LDL-C at admission with those at follow-up visit.

Results

A total number of 197 patients admitted to the Stroke Unit during March to November 2011 were enrolled in this study. Demographic data are presented in Table 1. There were slightly more male patients than female counterparts in most groups except in group D (patients with DM and statin use before admission). Their mean ages were comparable (60.54 to 63.32 years). The majority in each group never smoked and never drank of which the highest proportions of both habits were found in group D (78.95% and 84.21%, respectively). The highest proportions of present smoking (44.12%) and present drinking and 38.24%) were found in group A (no DM and no statin use before admission).

Table 1 Demographic data of 197 patients with ischemic stroke and hyperlipidemia.

Demographic data	Group			
	A (N = 68)	B (N = 59)	C (N = 32)	D (N = 38)
Gender (%)				
Male	47 (69.11%)	33 (55.93%)	17 (53.13%)	14 (36.84%)
Female	21 (30.89%)	26 (44.07)%	15 (46.87%)	24 (63.16%)
Mean age (years)	60.54	63.32	62.59	62.89
Standard deviation	13.29	12.68	10.94	9.66
Range	16 - 85	35 - 83	44 - 85	43 - 78
Smoking history (%)				
Never smoking	35 (51.47%)	39 (66.11%)	14 (43.75%)	30 (78.95%)
Past smoking	3 (4.41%)	1 (1.69%)	5 (15.63%)	1 (2.63%)
Present smoking	30 (44.12%)	18 (30.51%)	13 (40.62%)	7 (18.42%)
Unknown	0 (0.00%)	1 (1.69%)	0 (0.00%)	0 (0.00%)
Alcohol drinking (%)				
Never	39 (57.35%)	36 (61.02%)	18 (56.25%)	32 (84.21%)
Past drinking	3 (4.41%)	4 (6.78%)	3 (9.38%)	1 (2.63%)
Present drinking	26 (38.24%)	18 (30.51%)	11 (34.37%)	5 (13.16%)
Unknown	0 (0.00%)	1 (1.69%)	0 (0.00%)	0 (0.00%)

Note: Groups of patients: group A = patients with no diabetes mellitus (DM) and no statin use admission; group B = patients with no DM and with statin use admission; group C = patients with DM and no statin use admission; group D = patients with DM and statin use admission.
Past smoking = smoking was discontinued more than 1 year.
Past drinking = drinking was discontinued more than 1 year.

Laboratory data at admission and follow-up are presented in Table 2. Total cholesterol levels decreased significantly from admission both in groups A (from 206.24 to 147.61 mg/dL) and C (from 214.47 to 172.23 mg/dL) of which patients did not take any statin before admission (P < 0.001 for both groups). As expected, total cholesterol levels at admission in groups B (170.20 mg/dL) and D (172.23 mg/dL) where lower than those in groups A and C of which patients had not been any statins before admission.

HDL levels increased significantly in all groups where the mean HDL levels at follow-up of more than 45 mg/dL were found in all groups. Triglyceride levels decreased slightly from admission with no statistical significance.

Triglyceride levels decreased in all groups with no statistical significance. Patients in groups with statin use (groups B and D) had triglyceride levels at admission lower than their counterparts as expected.

ALT levels increased from admission among patients who did not use statin before admission (from 22.52 to 27.73 IU/L in group A and from 27.08 to 30.32 IU/L in group C), while those in patients who had been using statins decreased slightly (from 25.26 to 24.86 IU/L in group B and from 28.47 to 24.26 IU/L in group D). Changes in all 4 groups, however, did not reach any statistical significance. In constrast to ALT, AST levels decreased in all 4 groups with a statistical significance found in group D (from 31.59 to 23.37 IU/L, P = 0.014).

Creatine kinase levels were obtained in a very small number of patients in all 4 groups. Even with an increased level at follow-up in each of the 4 groups, creatine kinase levels cannot be test for statistical significance.

Fast blood sugar levels were found decreasing in all groups with no statistical significance. For HbA1c levels, a decrease in groups C and D (diabetes patients in both groups) was found with no statistical significance; while such changes with a very small magnitude were also found in patients with no diabetes (groups A and B) and could not be tested for statistical significance because a small number of patients were tested. As expected, patients with no diabetes (groups A and B) had fasting blood sugar and HbA1c levels lower than those of their counterparts.

In terms of LDL (Table 2), LDLD levels at admission in patients with statin use (106.05 mg/dL in group B and 113.37 mg/dL in group D) where higher than those in patients with no statin use (140.93 mg/dL in group A and 141.38 mg/dL in group C). Decreases in LDL levels at follow-up were found with statistical significance in all groups (P < 0.001, = 0.01, < 0.001 and = 0.01, in groups A, B, C and D respectively). Largest decreases were found in groups A (from 140.93 to 85.18 mg/dL) and C (from 141.38 to 100.43 mg/dL) of which the patients had not used any statins before admission.

Regarding LDL-goal achievement based on follow-up measures (Table 3), patients in group A and B (no diabetes) were expected to have an LDL level of less than 100 mg/dL) while those in groups C and D were to have less than 70 mg/dL. It was found that 82.22% and 68.89% of patients in groups A and B, respectively, and 21.74% and 37.04% of patients in groups C and D, respectively, achieved their respective LDL goals.

Table 2 Laboratory measures at admission and follow–up in 4 groups of patients.

Laboratory measures	Group A		*P*-value*	Group B		*P*-value*	Group C		*P*-value*	Group D		*P*-value*
	at admission	at follow-up		at admission	at follow-up		at admission	at follow-up		at admission	at follow-up	
Total cholesterol (mg/dL)												
Mean (SD)	206.24 (36.44)	147.61 (28.26)	< 0.001	170.20 (44.48)	159.91 (28.27)	0.604	214.47 (52.31)	172.23 (32.83)	< 0.001	174.33 (52.20)	161.71 (59.71)	0.148
Range	119 – 332	98 – 236		84 – 267	106 – 214		130 – 323	119 – 236		84 – 328	95 – 324	
No. of patients (%)	67 (98.53%)	28 (41.18%)		54 (91.53%)	32 (54.24%)		32 (100.00%)	13 (40.63%)		36 (94.74%)	17 (44.74%)	
LDL cholesterol (mg/dL)												
Mean (SD)	140.93 (34.98)	85.18 (22.75)	< 0.001	106.05 (36.91)	87.71 (25.54)	0.01	141.38 (39.04)	100.43 (43.03)	< 0.001	113.37 (43.96)	89.85 (41.21)	0.01
Range	62 – 283	11 – 326		35 - 185	10 – 406		81 - 236	14 - 262		43 - 223	14 – 327	
No. of patients (%)	68 (100.00%)	45 (66.18%)		59 (100.00%)	45 (76.27%)		32 (100.00%)	23 (71.88%)		38 (100.00%)	27 (71.05%)	
Duration, days (mean (SD)		133.17 (93.55)			136.60 (99.00)			91.45 (70.68)			112.92 (90.34)	
HDL cholesterol (mg/dL)												
Mean (SD)	43.29 (14.18)	48.06 (14.31)	0.023	39.14 (12.90)	46.94 (12.58)	0.002	37.09 (11.72)	45.07 (13.11)	0.001	36.95 (11.67)	46.63 (16.91)	0.008
Range	17 - 88	24 – 81		10 – 82	32 – 81		16 – 63	33 – 85		20 – 83	26 – 95	
No. of patients (%)	68 (100.00%)	34 (50.00%)		56 (94.92%)	35 (59.32%)		32 (100.00%)	15 (46.88%)		37 (97.37%)	19 (50%)	
Triglyceride (mg/dL)												
Mean (SD)	133.63 (72.09)	104.23 (37.22)	0.194	117.61 (71.03)	120.24 (59.29)	0.985	172.38 (84.78)	149.60 (76.22)	0.181	130.11 (43.43)	157.32 (95.21)	0.236
Range	55 – 475	42 – 198		40 – 397	37 – 300		65 – 336	60 – 336		54 – 240	52 – 456	
No. of patients (%)	68 (100.00%)	31 (45.59%)		57 (96.61%)	37 (62.71%)		32 (100%)	15 (46.88%)		37 (97.37%)	19 (50%)	
ALT (IU/L)												
Mean (SD)	22.52 (18.89)	27.73 (18.88)	0.366	25.26 (17.01)	24.86 (15.18)	0.747	27.08 (14.49)	30.32 (24.30)	0.456	28.47 (14.88)	24.26 (10.66)	0.277
Range	9 – 103	10 – 103		8 – 82	10 – 81		6 – 61	10 – 119		9 – 66	10 – 56	
No. of patients (%)	23 (33.82%)	33 (48.53%)		27 (45.76%)	37 (62.71%)		12 (37.50%)	19 (59.38%)		17 (44.74%)	19 (50%)	
AST (IU/L)												
Mean (SD)	27.45 (12.23)	26 (8.30)	0.110	30.56 (17.01)	28.03 (9.45)	0.804	25.92 (5.18%)	25.37 (8.76)	0.834	31.59 (11.12)	23.37 (7.48)	0.014
Range	14 - 56	11 – 56		12 – 86	13 – 57		18 – 34	13 – 48		15 – 54	13 – 39	
No. of patients (%)	22 (32.35%)	32 (47.06%)		27 (45.76%)	35 (59.32%)		12 (37.50%)	19 (59.38%)		17 (44.74%)	19 (50.00%)	
Creatine kinase (IU/L)												
Mean (SD)	88.33 (8.96)	117 (68.66)	-	80.25 (45.04)	134.27 (54.12)	0.295	85.00 (5.18)	99.50 (45.74)	-	77.00 (9.90)	95 (58.62)	-
Range	78 – 94	43 – 240		29 - 126	21 – 208		49 – 121	34 – 140		70 – 84	35 – 165	
No. of patients (%)	3 (4.41%)	6 (8.82%)		4 (6.77%)	11 (18.64%)		2 (6.25%)	4 (12.5%)		2 (5.26%)	5 (13.16%)	
Fasting blood sugar (mg/dL)												
Mean (SD)	97.90 (15.26)	101.26 (15.14)	0.268	102.33 (25.85)	101.21 (15.28)	0.139	160.38 (66.69)	152.48 (56.92)	0.71	136.97 (47.50)	128.35 (40.41)	0.576
Range	65 – 137	78 – 145		71 – 200	74 – 151		60 – 375	86 – 322		70 – 261	46 – 228	
No. of patients (%)	67 (98.53%)	39 (57.35%)		58 (98.31%)	33 (56.93%)		32 (100.00%)	23 (71.88%)		38 (100.00%)	31 (81.58%)	
HbA1c (%)												
Mean (SD)	6.28 (1.63)	6.4 (0.96)	-	5.98 (0.68)	5.7 (0.28)	-	9.15 (2.51)	8.85 (3.33)	0.779	7.95 (2.10)	6.9 (0.83)	0.427
Range	5.10 – 13.00	5.8 – 8		5 – 6.8	5.5 – 5.9		4.9 – 13.4	5.5 – 13.7		6 – 13	6 – 8.2	
No. of patients (%)	21 (30.88%)	5 (7.35%)		10 (16.95%)	2 (3.39%)		22 (68.75%)	6 (18.75%)		21 (55.26%)	5 (13.16%)	

* Paired t test comparing measure at admission with the one at follow-up, with a significance level of 0.05

Note: Groups of patients: group A = patients with no diabetes mellitus (DM) and no statin use before admission; group B = patients with no DM and with statin use before admission; group C = patients with DM and no statin use before admission; group D = patients with DM and statin use before admission.

Abbreviation: LDL = low density lipoprotein; HDL = high density lipoprotein; ALT = alanine aminotransferase; AST = aspartate aminotransferase; HbA1C = glycosylated hemoglobin.

There was no myalgia or rhabdomyolysis reported in this study (Table 4). Simvastatin was the most prescribed lipid lowering drug in patients with ischemic stroke and hyperlipidemia (176 cases, 89.34%), followed by atorvastatin (14 cases, 7.11%) (Table 4). Mean doses of simvastatin in each group were comparable, 20.49, 18.60, 20.0, and 21.71 mg in group A, B, C and D, respectively.

Discussions

According to the recommendation for lipid management from National Cholesterol Education Panel or NCEP III (Class I recommendations), the target goal of cholesterol lowering for those patients with CHD or symptomatic atherosclerotic disease is LDL-C level < 100 mg/dL; while the LDL-C level < 70 mg/dL is recommended for a very high

Table 3 LDL-C goal achievements

Group	LDL-C < 100 mg/dL			LDL-C ≥ 100 mg/dL		
	Number of patients (%)	Mean LDL-C (SD)	Range	Number of patients (%)	Mean LDL-C (SD)	Range
A (N = 45)	37 (82.22%)	77.76 (14.38)	42 - 99	8 (17.77%)	119.50 (23.48)	100 - 168
B (N = 45)	31 (68.89%)	75.00 (15.92)	38 - 98	14 (31.11%)	115.86 (19.60)	100 - 152
Group	**LDL < 70 mg/dL**			**LDL ≥ 70 mg/dL**		
	Number of patients (%)	Mean LDL-C (SD)	Range	Number of patients (%)	Mean LDL-C (SD)	Range
C (N = 23)	5 (21.74%)	55.60 (11.39)	41 – 67	18 (78.26%)	112.89 (40.13)	70 - 242
D (N = 27)	10 (37.04%)	57.10 (9.34)	39 - 68	17 (62.96%)	109.12 (40.56)	70 - 206

Note: Groups of patients: group A = patients with no diabetes mellitus (DM) and no statin use before admission; group B = patients with no DM and with statin use before admission; group C = patients with DM and no statin use before admission; group D = patients with DM and statin use before admission.
Abbreviation: LDL-C = low density lipoprotein cholesterol.

Table 4 Type of statins and adverse drug reactions classified by study groups.

	Group			
	A (N = 68)	B (N = 59)	C (N = 32)	D (N = 38)
Adverse drug reactions				
Myalgia	0	0	0	0
Rhadomyolysis	0	0	0	0
Statins				
Simvastatin	61 (89.7%)	50 (84.75%)	30 (93.80%)	35 (92.10%)
Atrovastatin	6 (8.80%)	5 (8.47%)	1 (3.10%)	2 (5.30%)
Rosuvastatin	1 (1.50%)	4 (6.78%)	1 (3.10%)	1 (2.60%)
Statin plus fibrate				
Gemfibrozil	0	1 (1.69%)	1 (3.13%)	0

Note: Groups of patients: group A = patients with no diabetes mellitus (DM) and no statin use before admission; group B = patients with no DM and with statin use before admission; group C = patients with DM and no statin use before admission; group D = patients with DM and statin use before admission.

risk person with multiple risk factors.[7] This present study classified 197 patients admitted at a stroke unit according to statin drug use history and the underlying disease of diabetes mellitus. After hospital discharge from stroke unit, the LDL-C achieved rate according to LDL-C goal accomplishment of < 100 mg/dL were 82.22% among patients patient without DM and no statin use before admission, and 68.89% among those without DM and with statin use before admission. In a previous study of patients with ischemic stroke or TIA admitted in the stroke service of a university teaching hospital, it was found that percent of individuals with LDL-C < 100 mg/dL at admission was 46% and then increased to 83% at 3 months after hospitalization but data of lipid lowering drug history was not disclosed.[8] L-TAP 2 study which was a survey performed in more than 10,000 patients in 9 countries, the success rate for LDL-C goal achievement (LDL-C < 100 mg/dL) was 73% overall, ranging from 47% to 84% across countries.[9] A high rate of LDL-C goal achievement in group A (82.22%) observed in our study may be due to an initiation of statin treatment for patients with ischemic stroke and TIA during their hospitalization. These patients might also had a high rate of adherence to statin therapy after hospital discharge. Such adherence could probably associate with a substantial improvement in the proportions of patients achieving target national guideline LDL-C goals 3 months after hospitalization.[10]

In patient without DM and had used statin (group B), both of the control rate of LDL-C according to LDL-C goal accomplishment and mean LDL-C at admission were lower than patients with no diabetes and no statin use. Previous study has shown that among patients in whom treatment with secondary preventive drugs was prescribed at discharge, the proportion on persistent medication during the first 4 months after discharge varied from 95.5% for antihypertensive drugs, 91.7% for statin drugs to 89.1% for warfarin. At 2 years, the rates had decreased to 74.2% for antihypertensive drugs, 56.1% for statin drugs and to 45.0% for warfarin.[11] Although this study did not record the history of statin use durations and adherence in sample, nonadherence after stroke was a major clinical problem in available evidence.[11]

In the study of Thailand Diabetes Registry Project entitled “Current Status of Dyslipidemia in Thai Diabetic Patients”[12], the achievement rate of the LDL-C target (< 70 mg/dL) in diabetic patients with history of cardiovascular disease was only 11.1%. Half of the patients (55%) were taking lipid–lowering medication; however, another one-third (30%) did not take any lipid-lowering medication even though they should.[12] According to American Diabetes Association recommendation, the LDL-C level < 70 mg/dl in type 2 DM with overt cardiovascular disease, about 28% of patients met target in Reality–Asia study.[13] Among 7,427 coronary artery disease (CAD) patients, 43% achieved an LDL-C goal (< 70 mg/dL), and 37% of those taking statin monotherapy[14]. In our study, diabetic patients with history of ischemic stroke or TIA who taking statin drugs attained the target LDL-C for 21.74% in those not taking statin and 37.04% in those taking statin before admission. A relatively low success rate may be

due to the use of statin with low potency (simvastatin) in the majority of our patients (176 cases, 89.34%); while in previous study[13], only 37% received statin with low potency.

Recent studies suggest that a more aggressive target for lipid lowering may have added benefits, LDL-C change showed that patients with > 50% LDL-C reduction had a 31% reduction in stroke risk (hazard ratio, 0.69, 95% CI, 0.55 to 0.87, *P* = 0.0016), a 33% reduction in ischemic stroke (*P* = 0.0018), no statistically significant increase in hemorrhagic stroke (*P* = 0.8864), and a 37% reduction in major coronary events (*P* = 0.0323).[15] In addition, every 1-mmole (39 mg/dL) decrease in LDL-C was associated with a 17% reduction in fatal and nonfatal stroke.[11] In our study, a more potent statin could have lead to a larger decrease in LDL and consequently a higher rate of LDL-goal achievement. Unfortunately, health care system of Thailand has the limitation of drug access, especially in patient with the universal coverage policy where high potency statins were not allowed in the majority of patients in this study. With the approval of atrovastatin in a dose of 40 mg in the essential drug list of Thailand in 2012, a higher rate of LDL-C goal achievement could be seen in the future. However, not only the use of high potency drug, other measures including education should be considered influential for achieving treatment goal.

In terms of adverse drug reaction, myalgia and rhabdomyolysis were not found in this study. Nevertheless, the means of ALT were not more than 3 times of upper normal limit at admission and follow-up. The changes in AST and ALT levels were not clinically or statistically significant. In clinical practice, when an increase in ALT levels was observed, physicians discontinue or reduce statin dosage. Another reason for lack of reported adverse effects was the possible incomplete information in the medical charts. In a previous study, myalgia and rhabdomyolysis were detected in 3.2% and 0.5% of patients, respectively.[16] A high occurrence of rhabdomyolysis was due to the concurrent use of high dosage of gemfibrozil (1,200 mg).[16] Nevertheless, the estimation of rhabdomyolysis from randomized control trial of statin is similar to the corresponding estimate from the cohort studies of 3.4 per 100,000 person-year.[16] The study of the effectiveness of additional reductions in cholesterol and homocysteine found that myopathy rate of was 0.9% associating with a high dose of simvastatin (80 mg/day) and 0.05% with a low dose (20 mg/day). Likewise, rhabdomyolysis rate in high dose of simvastatin (80 mg/day) was 0.12% and not found in low dose (20 mg/day).[17] In this study, the combination of simvastatin 20 mg and gemfibrozil 600 mg per day was prescribed in 2 cases, but adverse drug reaction was not found.

The absence of adverse drug reactions, myalgia or rhabdomyolysis, were seen due to the low dosage of statin drugs of which simvastatin and atrovastatin doses were not more than 40 mg per day and rosuvastatin was not more than 10 mg per day. Since data of adverse drug reactions were reviewed from medical chart, the estimate of adverse events may be underreported.

This study has few limitations. Since we did not exclude some patients who reached the goal of LDL-C level at admission, LDL-C goal achievement could be overestimated. Secondly, retrospective medical chart review in this study could lead to an underestimate of adverse drug reactions of statins. Findings from this study could help inform for multidisciplinary healthcare providers the success rate of LDL-goal achievement. A more aggressive hyperlipidemia therapy and an intensive patient education program should be encouraged.

Conclusion

This study determined the goal achievement of LDL-C in patients with ischemic stroke and hyperlipidemia at Prasat Neurological Institute. LDL-C goal accomplishment rates (LDL-C < 100 mg/dL) among patients with no diabetes were 82.22% and 68.89% for those without and with statin use before admission respectively. For patients with diabetes, LDL-C goal accomplishment rates (LDL < 70 mg/dL) of 21.74% and 37.04% were found in patients without and with statin use before admission respectively. Myalgia or rhabdomyolysis was not found in this study.

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