# Differentiation of Serum sLOX-1 and NO Levels in Acute Ischemic Stroke Patients with Internal Carotid Artery Stenosis and Those Without Internal Carotid Artery Stenosis

Pannawat Chaiyawatthanananthn BNS*,
Kesorn Suwanprasert PhD**, Sombat Muengtaweepongsa MD***

** PhD Student in Medical Science Program, Faculty of Medicine, Thammasat University, Pathumthani, Thailand*
*** Department of Preclinical Science, Faculty of Medicine, Thammasat University, Pathumthani, Thailand*
**** Department of Internal Medicine, Faculty of Medicine, Thammasat University, Pathumthani, Thailand*

***Background:*** *Soluble LOX-1 (sLOX-1) and nitric oxide (NO) are potential biomarkers for vascular oxidative stress that affect to atherosclerotic plaque. Atherosclerotic narrowing of the internal carotid artery is a well-known cause of acute ischemic stroke (AIS).*
***Objective:*** *To measure serums LOX-1and NO levels in acute ischemic stroke patients with or without ICA stenosis after 24-hour stroke symptom onset.*
***Material and Method:*** *118 patients with AIS within 24 hours-stroke symptom onset. Peripheral venous blood of all patients was collected for measuring blood sugar, cholesterol, triglyceride, HDL-c and LDL-c concentrations by standard laboratory techniques. Serum sLOX-1 and NO concentrations were measured by ELIZA kits. The patients were divided into two groups i.e. non-internal carotid artery stenosis (NICAS, n = 65) and internal carotidartery stenosis (ICAS, n = 53) by measuring internal carotid artery stenosis by ultrasound carotid duplex.*
***Results:*** *Baseline characteristics were not significantly different between NICAS and ICAS except LDL-c levels. Serum NO level had significantly lower in ICAS (50.09$\pm$7.36 µmol/l) when compared with NICAS (54.85$\pm$11.81 µmol/l). sLOX-1 had significantly higher in ICAS (1.82$\pm$0.34 ng/ml) compared with NICAS (1.13$\pm$0.40 ng/ml).*
***Conclusion:*** *There are higher sLOX-1 and lower NO levels in AIS patients with ICAS when comparing those with NICAS. These parameters may become the novel potential biomarkers for predicting risk to acute ischemic stroke.*

***Keywords:*** *Acute ischemic stroke, sLOX-1, Nitric oxide, Atherosclerotic plaque*

***J Med Assoc Thai 2016; 99 (Suppl. 4): S48-S53***
***Full text. e-Journal:*** *http://www.jmatonline.com*

Ischemic stroke is the important cause of adult disability particularly in elderly and remains the third most common cause of death in developing world[1] as well as in Thailand[2]. The prevalence of stroke is one percent in Thai people age more than 30 years old[3]. One of the most common causes of ischemic stroke is internal carotid atherosclerotic plaques inducing vascular oxidative stress leading to endothelial dysfunction and smooth muscle cell proliferation[4]. Atherosclerotic narrowing of the internal carotid artery is a well-known cause of acute ischemic stroke (AIS)[5]. Two major mechanisms of internal carotid plaque rupture are postulated to be the causes of acute ischemic stroke including distal emboli and significant lumen narrowing leading to decreasing of distal flow[6]. Lectin-like oxidized low-density lipoprotein receptor-1 (LOX-1) is a scavenged receptor for oxidized low-density lipoprotein (Ox-LDL), which affects atherosclerotic plaque progression[7]. LOX-1 can be cleaved from the cell surface by oxidative stress and releases as sLOX-1[8]. The circulating potential biomarkers of vascular oxidative stress are sLOX-1. During transient ischemic stroke, LOX-1 expression was early activated in rat non-neuronal cell type[9]. sLOX-1 levels increase in patients with coronary artery disease[10] and acute coronary syndrome[11]. The diseases are related with atherosclerosis which the same as AIS.

Nitric oxide (NO) is an important gas for maintained vascular system that generated by nitric

***Correspondence to:***
*Muengtaweepongsa S, Department of Internal Medicine, Faculty of Medicine, Thammasat University, Pathumthani 12120, Thailand.*
*Phone: +66-2-9269793*
*E-mail: sombatm@hotmail.com*

oxide synthase (NOS) endothelial cells. Previous study found that NO concentrations in cerebrospinal fluid were significantly higher in stroke and related with infarct volume[12]. Recently, plasma NO level is lower in patients with acute thrombotic stroke[13]. Moreover, some evidence suggested that increasing of inducible NOS (iNOS) expression in coronary atherosclerotic plaque of patients with unstable angina[14]. It is known that iNOS is a form of NOS that induced by inflammation, oxidative stress, and others.

These biomarkers are related with oxidative stress lead to developed atherosclerotic plaque until artery significant stenosis/occlusion or plaque rupture to emboli. This study investigated sLOX-1 and NO levels in AIS patients with or without internal carotid artery stenosis (ICAS).

## Material and Method

### *Sample size calculation*

In 2011, Hanchaiphiboolkul S et al found that the prevalence of stroke in Thailand is 1.88%[4]. Formula for calculated sample size per group is $n = Z_{\alpha/2}^{2} P (1-P) /d^2$ and replaced *p*-value is 0.0188, d value is 0.03, and *p*-value is 90% in the formula. Sample size is calculated about 56 persons per group x 2 groups = 112 persons. So, sample size in this study including $\pm$5% dropout is 118 cases.

### *Patient sample*

One hundred and eighteen patients with acute ischemic stroke within 24 hours after the onset (65 non-internal carotid artery stenosis: NICAS and 53 internal carotid artery stenosis $\geq$50%: ICAS) undergoing ultrasound carotid duplex (CD), Famio Cube model (SSA-520A) from Toshiba medical system corporation (Tochigi, Japan), from whom informed consent and blood samples were obtained and their sLOX-1 and NO date were available at the Thammasat University Hospital. All 118 patients were enrolled from September 2014 to April 2015. Venous blood samples were obtained after measuring NICAS or ICAS by CD. AIS was defined as acute onset of focal neurological deficits and was accompanied by Computer Tomography-Brain (CT-Brain), IQ on Spectral model from Philips North America Corporation (MA, USA) findings.

Patients with vasospastic angina, symptomatic peripheral vascular diseases, acute myocardial infarction (MI), diabetes mellitus (DM) orhyperglycemia (Blood sugar >180 mg/dl), or uncontrolled hypertension (Blood pressure >140/90 mmHg) were excluded from this study. Informed consent was obtained from the involved patients. This study had been approved by the Human Ethical Committee of Thammasat University No. 1 (Faculty of Medicine) and the number of approved protocol is MTU-EC-4-018/54

### *Blood chemical analysis*

Peripheral venous blood samplesof all 118 patients with acute ischemic stroke were obtained within 24 hours after the stroke symptom onset. The sample was centrifuged 3,000 rpm at 4°C for 15 minutes. Serum samples were frozen at -80°C until analysis. Serum blood sugar, cholesterol, triglycerides, high density lipoprotein cholesterol (HDL-c) and low density lipoprotein cholesterol (LDL-c) were measured by standard laboratory techniques on a Hitachi 7600 Automatic Biochemical Analyzer (Hitachi Co., Japan). Serum sLOX-1 and NO levels were determined using commercially available enzyme-linked immunosorbent assay (ELIZA) kits follow as the procedure (Sigma-Aldrish, MO, USA).

### *Statistical analysis*

All data are expressed as mean $\pm$ SD and statistical analyzed by SPSS version 13.0 for Windows (Chicago, IL, USA). Statistical analyses between two groups were performed with the unpaired t-test, Mann-Whitney U test or Chi-square test. Probability values of less than 0.05 will be considered to be statistically significant.

## Results

### *Baseline clinical characteristics*

Patients were grouped according to the presence or absence of internal carotid artery (ICA) stenosis, and their baseline characteristics are shown in Table 1. There were no significant differences in age, systolic or diastolic blood pressure, blood sugar, triglyceride, cholesterol and HDL-c between the two groups (all $p>0.05$). There were significant differences with respect to LDL-c between patients with ICAS and those without ICAS (all $p<0.05$).

### *Measurement of serum sLOX-1 and NO concentrations*

Their serum sLOX-1 and NO concentrations are shown in Table 2 as Mean $\pm$ SD. There were significant differences with respect to serum sLOX-1 and NO levels between patients with ICAS and NICAS (all $p<0.05$, Fig. 1).

As shown in Table 2, AIS patients with ICAS

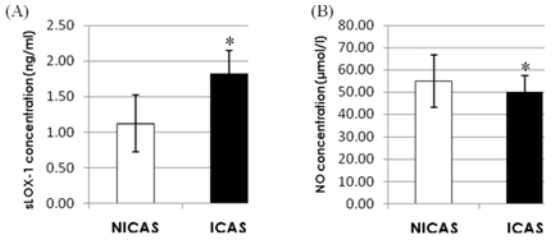
**Table 1.** Baseline clinical characteristics

| Parameters | NICAS (n = 65) | ICAS (n = 53) | *p*-value |
|---|---|---|---|
| | Mean ± SD | Mean ± SD | |
| Age (years) | 64.78±11.21 | 62.25±11.88 | 0.341 |
| Male, n (%) | 36 (55.38) | 30 (56.60) | 0.894 |
| SBP (mmHg) | 129.74±9.96 | 126.81±8.12 | 0.156 |
| DBP (mmHg) | 79.18±9.91 | 77.91±9.04 | 0.659 |
| Blood sugar (mg/dl) | 101.46±19.41 | 103.74±22.53 | 0.474 |
| Cholesterol (mg/dl) | 181.11±38.41 | 183.32±49.17 | 0.737 |
| Triglyceride (mg/dl) | 128.55±84.61 | 121.23±55.33 | 0.614 |
| HDL-c (mg/dl) | 48.31±11.99 | 50.53±13.77 | 0.254 |
| LDL-c (mg/dl) | 106.45±29.68 | 119.32±41.88 | 0.045 |

**Table 2.** Serum sLOX-1 and NO levels in patient with acute ischemic stroke within 24-hour stroke symptom onset

| Parameters | NICAS (n = 65) | ICAS (n = 53) | *p*-value |
|---|---|---|---|
| | Mean ± SD | Mean ± SD | |
| sLOX-1 levels (ng/ml) | 1.13±0.40 | 1.82±0.34 | <0.001 |
| NO levels (μmol/l) | 54.85±11.81 | 50.09±7.36 | 0.024 |

had significantly higher serum sLOX-1 levels than those without ICAS (1.82 [range 1.48 to 2.16] vs. 1.13 [range 0.73 to 1.53] ng/ml $p<0.001$) and significantly less serum NO levels than those without ICAS (50.09 [range 42.64 to 57.45)] vs. 54.85 [range 43.04 to 66.66] μmol/l, $p = 0.024$).




* $p<0.05$ vs. NICAS group

**Fig. 1** Serum sLOX-1 (A) and NO (B) levels of patients with acute ischemic stroke that compare to non-ICA stenosis(NICAS) and ICA stenosis (ICAS) within 24 hours of stroke symptom onset.

## Discussion

AIS patients with ICAS have significantly higher serums LOX-1 levels than and lower NO levels than those without ICAS. To our knowledge, this is the first report, which addresses the relationship between sLOX-1 together with NO levels and ICAS in patients with AIS. However, we were not able to deny whether the high serum sLOX-1 levels or low NO levels were pre-existing findings in patients with ICAS before development of AIS. This study comparison of sLOX-1 levels together with NO levels between ICAS with AIS (symptomatic ICAS) and asymptomatic ICAS is suggested.

ICAS is a major risk factor for the development of AIS[15]. Therefore, early prediction of the risk of the AIS patients with ICAS is of critical importance. In recent years, non-invasive blood biomarkers have emerged as important tools for diagnosis, risk stratification and therapeutic decision-making for patients with cerebrovascular disease. The findings of the present study are that among patients with AIS, high serum sLOX-1 levels were significantly associated with the presence of carotid duplex-significant ICAS. These findings may help to explain the missing cross-talk between two biomarkers and AIS caused from arterial plaque stenosis. The involvement of LOX-1 is a factor that affects to development of atherosclerosis from several factors e.g. dyslipidemia plays the major role in the up-regulation of LOX-1 through ox-LDL stimulation[16], hyperglycemia increased LOX-1 up-regulation in human endothelial cells via activation of

reactive oxygen species (ROS)[17], and hypertension up-regulated the expression ofLOX-1 by induction of angiotensin II[18]. Previous studies have also found that sLOX-1 are significantly increased in obesity[19] and type 2 DM[20]. The activation of LOX-1 affects to atherosclerotic plaque formation and progression through dysfunction of endothelial cells[21], apoptosis of vascular smooth muscle cells[22], accumulation of lipids in macrophages[23], and production of matrix metalloproteinase[24]. Our study suggests that LOX-1 plays an important role in the cross-talk between ICAS and AIS, and high sLOX-1 level could perhaps be use fulto-predict the occurrence of future cerebrovascular events in patients with ICAS. This study shows that low serum NO levels are significantly associated with ICAS when compared with NICAS but it over the normal range from 19.7 to 44 µmol/l in healthy population[25]. Decreased NO levels might lead to high LDL-c in AIS patients with ICAS and they are oxidized into ox-LDL activating endothelial cell dysfunction via iNOS. Previous studies suggest that iNOS over-expression is found in patients with coronary atherosclerotic plaque[16]. These results suggest that sLOX-1 and NO might play a key role in the progression of atherosclerotic plaque.

The limitations of this study merit consideration. First, this study was cross-sectional, thereby allowing the determination of associations, but not formulation of risk predictions. In addition, the study populations were relatively small. Therefore, our findings need further investigation in prospective studies with larger sample size. Last, sLOX-1 and NO levels might be higher or lower in patients with ICAS than in general population. Therefore, a normal control group should be included in future studies to evaluate the degree of impact that the presence and severity of AIS and ICAS can give on sLOX-1 and NO levels and to better understand the role of sLOX-1 and NO levels in AIS patients with ICAS.

## Conclusion

This study shows that serum sLOX-1 levels are significantly higher while serum NO levels are significantly lower in AIS patients with ICAS when compared with those without ICAS. If these results are confirmed by further clinical studies, sLOX-1 and NO level may be the one of promising biomarker for predicting risk to AIS in patients with ICAS.

## What is already known on this topic?

The involvement of LOX-1 is a factor that affects to development of atherosclerosis from several factors e.g. dyslipidemia plays the major role in the up-regulation of LOX-1 through ox-LDL stimulation, hyperglycemia increased LOX-1 up-regulation in human endothelial cells via activation of reactive oxygen species (ROS), and hypertension up-regulated the expression of LOX-1 by induction of angiotensin II. Previous studies have also found that sLOX-1 are significantly increased in obesity and type 2 DM. The activation of LOX-1 affects to atherosclerotic plaque formation and progression through dysfunction of endothelial cells, apoptosis of vascular smooth muscle cells, accumulation of lipids in macrophages, and production of matrix metalloproteinases. However, no previous study has addressed the relationship between sLOX-1 together with NO levels and ICAS in patients with AIS before.

## What this study adds?

To our knowledge, this is the first report which addresses the relationship between sLOX-1 together with NO levels and ICAS in patients with AIS.

## Acknowledgement

This study is supported by The National Research University Project of Thailand from Office of Higher Education Commission and Center of Excellence in Integrated Sciences for Holistic Stroke Research from Thammasat University.

## Potential conflicts of interest

None.

## References

1. Lopez AD, Mathers CD, Ezzati M, Jamison DT, Murray CJ. Global and regional burden of disease and risk factors, 2001: systematic analysis of population health data. Lancet 2006; 367: 1747-57.
2. Stroke epidemiological data of nine Asian countries. Asian Acute Stroke Advisory Panel (AASAP). J Med Assoc Thai 2000; 83: 1-7.
3. Poungvarin N. Burden of stroke in Thailand. Int J Stroke 2007; 2: 127-8.
4. Hanchaiphiboolkul S, Poungvarin N, Nidhinandana S, Suwanwela NC, Puthkhao P, Towanabut S, et al. Prevalence of stroke and stroke risk factors in Thailand: Thai Epidemiologic Stroke (TES) Study. J Med Assoc Thai 2011; 94: 427-36.
5. Palangrit S, Muengtaweepongsa S. Risk Factors of Stroke in Pathumthani Province, Thailand. J Med Assoc Thai 2015; 98: 649-55.

6. Madamanchi NR, Vendrov A, Runge MS. Oxidative stress and vascular disease. Arterioscler Thromb Vasc Biol 2005; 25: 29-38.
7. Szabo K, Kern R, Gass A, Hirsch J, Hennerici M. Acute stroke patterns in patients with internal carotid artery disease: a diffusion-weighted magnetic resonance imaging study. Stroke 2001; 32: 1323-9.
8. Hossmann KA, Heiss WD. Neuropathology and pathophysiology of stroke. In: Brainin M, Heiss WD, editor. Textbook of stroke medicine. Cambridge, UK: Cambridge University Press; 2010: 1-27.
9. Kume N, Murase T, Moriwaki H, Aoyama T, Sawamura T, Masaki T, et al. Inducible expression of lectin-like oxidized LDL receptor-1 in vascular endothelial cells. Circ Res 1998; 83: 322-7.
10. Murase T, Kume N, Kataoka H, Minami M, Sawamura T, Masaki T, et al. Identification of soluble forms of lectin-like oxidized LDL receptor-1. Arterioscler Thromb Vasc Biol 2000; 20: 715-20.
11. Schwarz DA, Barry G, Mackay KB, Manu F, Naeve GS, Vana AM, et al. Identification of differentially expressed genes induced by transient ischemic stroke. Brain Res Mol Brain Res 2002; 101: 12-22.
12. Li B, Zhang LH, Yang XG, Liu XT, Ren YG. Serum sLOX-1 levels are associated with the presence and severity of angiographic coronary artery disease in patients with metabolic syndrome. Clin Invest Med 2010; 33: E398-404.
13. Hayashida K, Kume N, Murase T, Minami M, Nakagawa D, Inada T, et al. Serum soluble lectin-like oxidized low-density lipoprotein receptor-1 levels are elevated in acute coronary syndrome: a novel marker for early diagnosis. Circulation 2005; 112: 812-8.
14. Castillo J, Rama R, Davalos A. Nitric oxide-related brain damage in acute ischemic stroke. Stroke 2000; 31: 852-7.
15. Cano CP, Bermudez VP, Atencio HE, Medina MT, Anilsa A, Souki A, et al. Increased serum malondialdehyde and decreased nitric oxide within 24 hours of thrombotic stroke onset. Am J Ther 2003; 10: 473-6.
16. Depre C, Havaux X, Renkin J, Vanoverschelde JL, Wijns W. Expression of inducible nitric oxide synthase in human coronary atherosclerotic plaque. Cardiovasc Res 1999; 41: 465-72.
17. Adams HP Jr, Bendixen BH, Kappelle LJ, Biller J, Love BB, Gordon DL, et al. Classification of subtype of acute ischemic stroke. Definitions for use in a multicenter clinical trial. TOAST. Trial of Org 10172 in Acute Stroke Treatment. Stroke 1993; 24: 35-41.
18. Chen H, Li D, Sawamura T, Inoue K, Mehta JL. Upregulation of LOX-1 expression in aorta of hypercholesterolemic rabbits: modulation by losartan. Biochem Biophys Res Commun 2000; 276: 1100-4.
19. Taye A, Saad AH, Kumar AH, Morawietz H. Effect of apocynin on NADPH oxidase-mediated oxidative stress-LOX-1-eNOS pathway in human endothelial cells exposed to high glucose. Eur J Pharmacol 2010; 627: 42-8.
20. Hu C, Dandapat A, Sun L, Marwali MR, Inoue N, Sugawara F, et al. Modulation of angiotensin II-mediated hypertension and cardiac remodeling by lectin-like oxidized low-density lipoprotein receptor-1 deletion. Hypertension 2008; 52: 556-62.
21. Brinkley TE, Kume N, Mitsuoka H, Phares DA, Hagberg JM. Elevated soluble lectin-like oxidized LDL receptor-1 (sLOX-1) levels in obese postmenopausal women. Obesity (Silver Spring) 2008; 16: 1454-6.
22. Tan KC, Shiu SW, Wong Y, Leng L, Bucala R. Soluble lectin-like oxidized low density lipoprotein receptor-1 in type 2 diabetes mellitus. J Lipid Res 2008; 49: 1438-44.
23. Li D, Mehta JL. Antisense to LOX-1 inhibits oxidized LDL-mediated upregulation of monocyte chemoattractant protein-1 and monocyte adhesion to human coronary artery endothelial cells. Circulation 2000; 101: 2889-95.
24. Kume N, Kita T. Apoptosis of vascular cells by oxidized LDL: involvement of caspases and LOX-1 and its implication in atherosclerotic plaque rupture. Circ Res 2004; 94: 269-70.
25. Smirnova IV, Kajstura M, Sawamura T, Goligorsky MS. Asymmetric dimethylarginine upregulates LOX-1 in activated macrophages: role in foam cell formation. Am J Physiol Heart Circ Physiol 2004; 287: H782-H790.
26. Li D, Liu L, Chen H, Sawamura T, Ranganathan S, Mehta JL. LOX-1 mediates oxidized low-density lipoprotein-induced expression of matrix metalloproteinases in human coronary artery endothelial cells. Circulation 2003; 107: 612-7.
27. Viinikka L. Nitric oxide as a challenge for the clinical chemistry laboratory. Scand J Clin Lab Invest 1996; 56: 577-81.

# ความแตกต่างของระดับเลกตินไลค์ไลโปโปรตีนที่มีความหนาแน่นต่ำ (sLOX-1) และระดับไนตริกออกไซด์ (NO) ในซีรัมของผู้ป่วยโรคหลอดเลือดสมองตีบและตันระยะเฉียบพลัน (acute ischemic stroke) ที่มีการตีบตันของหลอดเลือดแดงที่ internal carotid artery และผู้ป่วยโรคหลอดเลือดสมองตีบและตันระยะเฉียบพลันที่ไม่มีการตีบตันของหลอดเลือดแดงที่ internal carotid artery

ปรรณณวัชญ์ ไชยวัฒนนันทน์, เกสร สุวรรณประเสริฐ, สมบัติ มุ่งทวีพงษา

**ภูมิหลัง:** ระดับของ soluble lectin-like oxidized low-density lipoprotein receptor-1 (sLOX-1) และ nitric oxide (NO) ในกระแสเลือดเป็นตัวชี้วัดทางที่สำคัญสำหรับภาวะ oxidative stress ในกระแสเลือดที่ส่งผลให้เกิดคราบในหลอดเลือดแดง การตีบตันของคราบในหลอดเลือดของหลอดเลือดแดงที่ internal carotid artery (ICA) ทำให้การไหลเวียนของเลือดไปสมองลดลงและเป็นสาเหตุของการเกิดโรคหลอดเลือดสมองตีบและตันระยะเฉียบพลัน

**วัตถุประสงค์:** เพื่อเปรียบเทียบระดับของ sLOX-1 และ NO ในซีรัมของผู้ป่วยโรคหลอดเลือดสมองตีบและตันระยะฉียบพลันที่มีและไม่มีการตีบตันของคราบในหลอดเลือดของหลอดเลือดแดงที่ ICA ภายใน 24 ชั่วโมงหลังมีอาการแสดงของโรคหลอดเลือดสมอง

**วัสดุและวิธีการ:** ผู้ป่วยโรคหลอดเลือดสมองตีบและตันระยะเฉียบพลันที่มีอาการแสดงของโรคหลอดเลือดสมองภายใน 24 ชั่วโมง จำนวน 118 ราย จะได้รับการบันทึกเกี่ยวข้อมูลทางสุขภาพพื้นฐานได้แก่ เพศ อายุ และความดันโลหิต เป็นต้น และได้รับการเจาะเลือดเพื่อนำไปตรวจวัดระดับน้ำตาลในเลือด คอลเลสเตอรอลไตรกลีเซอไรด์ ไลโปโปรตีนที่มีความหนาแน่นสูง (HDL-c) ไลโปโปรตีนที่มีความหนาแน่นต่ำ (LDL-c) sLOX-1 และ NO แล้วจะได้รับการตรวจด้วยเครื่องอัลตร้าซาวด์เพื่อประเมินการตีบตันของหลอดเลือดแดงที่ ICA แบ่งกลุ่มผู้ป่วยออกเป็น 2 กลุ่ม คือ กลุ่มที่ 1 เป็นผู้ป่วยที่ไม่มีการตีบตันของหลอดเลือดแดงที่ ICA จำนวน 65 ราย และกลุ่มที่ 2 เป็นผู้ป่วยที่มีการตีบตันของหลอดเลือดแดงบริเวณคอที่ ICA มากกว่า 50% จำนวน 53 ราย แล้วนำข้อมูลที่ได้มาเปรียบเทียบระหว่าง 2 กลุ่มด้วยวิธีทางสถิติ

**ผลการศึกษา:** ลักษณะข้อมูลพื้นฐานทางคลินิก ได้แก่ เพศ อายุ ความดันโลหิต ระดับของน้ำตาลในเลือด คอลเลสเตอรอล ไตรกลีเซอไรด์ และ HDL-c ไม่มีความแตกต่างกันระหว่าง 2 กลุ่ม ยกเว้น LDL-c และพบว่ากลุ่มที่ 2 มีระดับของ sLOX-1 ในซีรัมสูงกว่ากลุ่มที่ 1 เท่ากับ 1.82±0.34 และ 1.13±0.40 นาโนกรัมต่อมิลลิลิตร ตามลำดับ และกลุ่มที่ 2 มีระดับของ NO ในซีรัมต่ำกว่ากลุ่มที่ 1 เท่ากับ 50.09±7.36 และ 54.85±11.81 ไมโครโมลต่อลิตรตามลำดับอย่างมีนัยสำคัญทางสถิติ

**สรุป:** ผู้ป่วยโรคหลอดเลือดสมองตีบและตันระยะเฉียบพลันที่มีการตีบตันของหลอดเลือดแดงที่ ICA มีระดับของ sLOX-1 ในซีรัมสูงกว่า และระดับของ NO ในซีรัมต่ำกว่าผู้ป่วยโรคหลอดเลือดสมองตีบและตันระยะเฉียบพลันที่ไม่มีการตีบตันของหลอดเลือดแดงที่ ICA ตัวชี้วัดเหล่านี้อาจจะเป็นตัวชี้วัดทางชีวภาพตัวใหม่สำหรับการทำนายโอกาสเกิดโรคหลอดเลือดสมองตีบและตันระยะเฉียบพลัน