

LIPOPROTEIN (A) AND ARTERIAL STIFFNESS IN PATIENTS WITH DIABETES MELLITUS

by Jehan Wiendrati Roostarini

Submission date: 26-Aug-2019 12:05PM (UTC+0800)

Submission ID: 1163455654

File name: c1c7f2ed.pdf (266.79K)

Word count: 3336

Character count: 16442



24
**LIPOPROTEIN (A) AND ARTERIAL STIFFNESS
IN PATIENTS WITH DIABETES MELLITUS**

**JEHAN WIENDRATI ROOSTARINI, SOEBAGJO ADI SOELISTIJO*, HERMINA NOVIDA,
ARI SUTJAHJO, SONY WIBISONO, JONGKY HENDRO PRAJITNO, HERMAWAN SUSANTO,
MUHAMMAD MIFTAHUSSURUR, ASKANDAR TJOKROPRAWIRO**

8
Department of Internal Medicine, Faculty of Medicine, Universitas Airlangga, Dr. Soetomo Teaching Hospital, Surabaya, Indonesia

Received 15.12.2018; accepted for printing 10.01.2019

14
ABSTRACT

Background: Type 2 Diabetes Mellitus (T2DM) increases morbidity and mortality of cardiovascular disease including atherosclerotic complications. The pathogenesis of atherosclerosis in T2DM is primarily due to changes in lipid profiles and lipoproteins. High levels of lipoprotein (a)/Lp (a) are known to be a risk factor for atherosclerosis. However, the correlation between Lp (a) levels and arterial stiffness has not been widely known.

Objectives: To determine the correlation between Lp (a) and arterial stiffness measured by brachial-ankle pulse wave velocity (baPWV) in patients with T2DM in Endocrine Metabolic and Diabetes Unit of RSUD Dr. Soetomo Teaching Surabaya.

Methods: The cross-sectional observational analytical research was conducted on T2DM patients aged ≥ 45 in Endocrine Metabolic and Diabetes Unit of Dr. Soetomo Teaching Hospital from June 2015 to August 2015. T2DM was determined based on the American Diabetes Association (ADA) 2014 criteria. Lp (a) was measured using Latex agglutination test and arterial stiffness was measured by baPWV.

Results: Among 39 T2DM patients, 25.6% had Lp (a) ≥ 30 mg/dL with mean of Lp (a) levels of 21.66 ± 18.67 mg/dL and 94.9% of patients had the mean of baPWV of 16.61 ± 2.57 cm/s. The correlation result of Lp (a) and baPWV showed $p = 0.88$ and $r = 0.026$.

Conclusion: There was no correlation between Lp (a) and arterial stiffness (using baPWV measurement) in patients with T2DM.

10
KEYWORDS: lipoprotein (a), arterial stiffness, diabetes mellitus

INTRODUCTION

Lipoprotein (a) [Lp (a)] is an independent risk factor of atherosclerosis (1,2). Several studies have reported macrovascular complications in T2DM associated with high levels of Lp (a) (3,4). Other studies reported Lp (a) levels in T2DM patients did not change and did not correlate with diabetic status or arterial stiffness (5-8).

The increasing number of T2DM patients in Indonesia especially in Jakarta (5.7% in 1993 to 12.8% in 2001), led to an increase of mortality and high disability derived from macrovascular complications that manifest as atherosclerosis (9).

ADDRESS FOR CORRESPONDENCE:

5 Soebagjo Adi, MD., Ph.D
Division of Metabolic Endocrinology, Department of Internal Medicine, Faculty of Medicine, Universitas Airlangga, Dr. Soetomo Teaching Hospital, Surabaya 60285, Indonesia.
Phone: +6231-550-1466
E-mail: soebagjo@yahoo.com

There are various ways to measure the arterial stiffness in atherosclerosis but none of them becomes the gold standard. Arterial stiffness can be measured using carotid femur-Pulse Wave Velocity (cfPWV) and Cardiovascular-Index (CAVI) with insignificant results. Brachial ankle-Pulse wave velocity (baPWV) is believed to be the most reliable and the best measurement of artery stiffness (10). A study by Wakabayashi et. al. (11) mentioned that there was a significant correlation between Lp (a) levels and arterial stiffness measured by baPWV.

Therefore, we hypothesize that there is a correlation between Lp (a) levels with arterial stiffness (using baPWV measurements) in patients with T2DM. The study aims to determine the correlation of Lp (a) levels with artery stiffness measured by baPWV in T2DM patient who in Endocrine Unit-Internal Medicine Department of Dr. Soetomo Teaching Surabaya.

METHODS

Population

This study used observational analytic research with cross sectional design. There were 39 patients of T2DM who in the Endocrine Metabolic Unit-Internal Medicine Department of Dr. Soetomo Teaching Hospital who participated in this study. Patients with T2DM were determined based on one of these criteria: clinical history of T2DM or with classic symptom of DM with HbA1c $\geq 6.5\%$ or fasting venous blood sugar ≥ 126 mg/dL or glucose ≥ 200 mg/dL during Oral Glucose Tolerance Test by ADA 2014. The subjects met the inclusion criteria (patients with Type 2 DM; and men and women aged ≥ 45 years) but not exclusion criteria (patients with hepatic dysfunction, renal function, pregnant women undergo estrogen-progesterone hormone therapy, usage of niacin drugs, patients with infections, patients with chronic inflammatory diseases, and malignant patients). All subjects have agreed and signed the informed consent. Characteristics of subjects such as sex, HbA1c, BMI, hypertension, dyslipidemia, smoking activity were recorded.

Lipoprotein (a) levels were determined by the latex immunoassay method at PROLABA Laboratory Surabaya. The normal value of Lp (a) is < 30 mg/dL, while Lp (a) ≥ 30 mg/dL is considered high (11,12). Arterial stiffness was measured using baPWV in the Diabetes and Nutrition Center of Dr. Soetomo Teaching Hospital Surabaya. Faster pulse wave time obtained compared to normal condition (more than 1350 cm/sec) indicates a vascular rigidity. The baPWV has sensitivity and specificity of 91% and 75%, respectively, in ABI = 0.095. Values were expressed by variable ratio (13).

RESULTS

Analysis on 39 patients with T2DM obtained the mean age of T2DM patients was 59.26 ± 8.03 years, with the youngest age of 46 years and the oldest of 77 years. The female group was higher than the male group with a ratio of 41:59.

The results of Lp (a) examination of 39 samples showed the mean of Lp (a) level was 31.66 ± 18.67 mg/dL with 2 patients had the lowest Lp (a) levels of 2.8 mg/dL and 1 patient with the highest Lp (a) levels of 66 mg/dL. The cut off used for Lp (a) level was 30 mg / dL, thus there were 10 samples with high Lp (a) levels meanwhile most of the sample had normal Lp (a) levels.

The mean of Lp (a) levels in women was higher than the male group; 27.94 ± 22.37 and 17.28 ± 14.57 with the Mann-Whitney test obtained $p = 0.16$. Therefore, it concluded that there was no difference on the mean of Lp (a) levels in the group of male and female. HbA1c, BMI and smoking variables were tested with an independent-sample t-test. HbA1c's variable analysis test obtained $p = 0.93$, thus it concluded that there was no difference on the mean of Lp (a) level in the group of HbA1c $< 7\%$ and the group of HbA1c $\geq 7\%$, with mean in each group by 17.28 ± 14.57 and 22.38 ± 18.47 . Distribution of lipoprotein (a) levels for each characteristic of subjects are shown in table 1.

The analysis test on hypertension variable obtained $p = 0.87$, meanwhile the analysis test on the variable of dyslipidemi obtained $p = 0.89$, it concluded that there was no difference on the mean of Lp (a) level in the group with hypertension and dyslipidemi or undiagnosed group. Test analysis on smoking or non-smoking group obtained $p = 0.34$, thus there was no difference of Lp (a) level in each group.

The results of baPWV examination showed the mean of the pulse wave of 16.61 ± 2.57 cm/sec. There were 2 patients within normal limits (< 1350 cm/sec) and most of the samples showed a vascular stiffness; 37 patients with a pulse of ≥ 1350 cm/sec. The distribution of baPWV examination for each characteristic of subjects are shown in table 2.

TABLE 1

Results of Bivariate Analysis and Distribution of Lp (a) on Each Basic Characteristics of Samples

| Characteristics Variable | Lipoprotein(a) Mean \pm SD (mg/dL) | Range | | P |
|--------------------------|--------------------------------------|-------|------|------|
| | | Min. | Max. | |
| Sex | | | | |
| Male | 17.28 \pm 14.57 | 3 | 66 | 0.16 |
| Female | 27.94 \pm 22.37 | 2.8 | 52 | |
| HbA1c | | | | |
| <7% | 17.28 \pm 14.57 | 2.8 | 59 | 0.93 |
| $\geq 7\%$ | 22.38 \pm 18.47 | 3 | 66 | |
| BMI | | | | |
| Normal | 18.97 \pm 19.24 | 2.8 | 57 | 0.69 |
| Overweight | 17.5 \pm 20.97 | 2.8 | 66 | |
| Hypertension | | | | |
| Yes | 21.87 \pm 18.74 | 2.8 | 66 | 0.87 |
| No | 20.20 \pm 20.30 | 4 | 52 | |
| Dyslipidemia | | | | |
| Yes | 21.88 \pm 18.87 | 2.8 | 66 | 0.89 |
| No | 13 \pm 0 | 13 | | |
| Smoking | | | | |
| Yes | 11.00 \pm 9.9 | 4 | 18 | 0.34 |
| No | 19.74 \pm 16.28 | 2.8 | 66 | |

TABLE 2.

Results of Bivariate Analysis and Distribution of baPWV on Each Basic Characteristics of Samples

| Characteristics Variable | baPWV Mean±SD (cm/detik) | Range | | p |
|--------------------------|--------------------------|-------|------|------|
| | | Min | Max | |
| Sex | | | | |
| Male | 17.07±2.14 | 13.9 | 21.3 | 0.31 |
| Female | 17.07±2.14 | 11.5 | 24.1 | |
| HbA1c | | | | |
| <7% | 15.92±2.37 | 12.6 | 21.1 | 0.35 |
| ≥7% | 16.82±2.63 | 11.5 | 24.1 | |
| BMI | | | | |
| Normal | 16.09±1.57 | 13.2 | 18.4 | 0.42 |
| Overweight | 16.72±2.74 | 11.5 | 24.1 | |
| Hypertension | | | | |
| Yes | 16.88±2.59 | 11.5 | 24.1 | 0.44 |
| No | 14.80±1.60 | 13.2 | 16.8 | |
| Dyslipidemia | | | | |
| Yes | 16.65±2.59 | 11.5 | 24.1 | 0.56 |
| No | 15.35±0 | 15.4 | 15.4 | |
| Smoking | | | | |
| Yes | 20.43±5.20 | 16.8 | 24.1 | 0.20 |
| No | 16.41±2.31 | 11.5 | 21.3 | |

The analysis of each variable was obtained as follows: sex $p = 0.31$, HbA1c $p = 0.35$, IMT $p = 0.42$, hypertension $p = 0.44$, dyslipidemia $p = 0.56$ and smoking $p = 0.20$, therefore it concluded that there was no difference between the mean of baPWV value on all characteristic variables ($p > 0.05$).

DISCUSSION

Lipoprotein (a) and arterial stiffness are known as markers associated with atherosclerosis. The influence of Lp (a) with atherosclerosis through 2 mechanisms, namely 1.) The mechanism of atherogenesis through the oxidation process of Lp (a) and uptake Lp (a) by macrophages into the intima tunica, it is similar to LDL and Lp (a) that also causes rupture of atherom plaque. 2.) Thrombosis mechanism through partial homology between apo (a) and plasminogen resulting in binding competition to plasminogen receptors in the endothelium. Lipoprotein (a) also causes PAI-1 to increase; thereby it inhibits plasminogen into plasmin resulting in decreased fibrinolysis process. A study by Tsimikas (14) reported that Lp (a) had a strong relationship with atherosclerosis. Momiyama et al (15) reported the concentration of Lp (a) indicated a correlation with the progression of stenosis and is an independent factor against atherosclerosis. A study by El Gendi et al (16) also reported

that Lp levels (a) related to the thickness of the tunica intima carotid artery.

This study showed that Lp (a) and plasminogen competed in the binding process in target cell surface receptors (endothelial cells) and fibrin, and inhibited the fibrinolytic activity of plasminogen (17,18). The formation of plasmin decreased due to the competitive process of Lp (a) to the receptors on the surface of fibrin and targeted cells by some K-IV coffee, thus it caused fibrin and lipid deposits in the vascular wall leads to thrombogenesis processes (17).

Lipoprotein (a) has a high affinity for fibrinogen and fibrin which can inhibit plasminogen to bind. The competitive process of Lp (a) and plasminogen over fibrin is the basis for the formation of atherosclerotic plaque. The fibrinolytic effect of Lp (a) is also determined by apo (a) polymorphism which also describes the activity of lipoprotein fibrin binding to fibrin. The affinity of Lp (a) to fibrin depends on the size and concentration of lipoproteins; the size of Lp (a) is smaller, then the affinity for fibrin is higher (8).

The studies by Kotani et al (19), Wakayabashi et al study (11), Matsunatsu et al (5) mentioned that the mean value of Lp (a) were 5 mg/dL, 18.6 mg/dL and 16.5 mg/dL respectively. The mean of Lp (a) in this study was 21.66±18.67 mg/dL. Several studies conducted in Japan obtained a lower mean value than this study. This may be due to this research was conducted in different countries, besides the genetic factors also played a role in determining Lp (a) levels.

Although some studies have reported that Lp (a) was correlated with atherosclerosis, this study has not been able to demonstrate the correlation. This might be due to the number of samples with high Lp (a) level were 25.6% meanwhile the artery stiffness were 94.87%. In addition, this insignificant correlation was also assumed due to the confounding variables that could not be controlled during the sample selection process. This variable consisted of genetic factors, age, sex, BMI, duration of DM, dyslipidemia, and hypertension.

Increased arterial stiffness in T2DM patients may occur in both central and peripheral arteries, baPWV examination may describe the stiffness of the arteries, both central and peripheral. The baPWV sensitivity was 91% and the specificity

was 75% in $ABI = 0.095$. Whereas in ABI , the sensitivity < 0.95 and its specificity decreased (13).

The mean of $baPWV$ in this study was 16.61 ± 2.57 cm/sec, whereas a study by Funatsu et al [5] obtained the mean of $baPWV$ by 18.5 ± 4.8 cm/sec. The study by Funatsu obtained larger $baPWV$ results due to diabetic retinopathy as one of the inclusion criteria, so the study sample had been subjected to microvascular disorders.

The subjects of this study were associated with high risk factors, as indicated by the number of subjects with poor blood sugar control, obesity, hypertension, and dyslipidemia. Although these confounding factors were not reported to affect $Lp(a)$ levels, but these confounding factors greatly affected the stiffness of the arteries.

ACKNOWLEDGEMENT: Authors acknowledge Universitas Airlangga for submitting this manuscript to repository.unair.ac.id/32946/ for internal academic purposes.

REFERENCES

1. Sharma S, Merchant J, Fleming SE. $Lp(a)$ -cholesterol is associated with HDL-cholesterol in overweight and obese African American children and is not an independent risk factor for CVD. *Cardiovasc Diabetol* [Internet]. 2012 Jan 27 [cited 2019 Jan 27];11:10. Available from: <http://www.ncbi.nlm.nih.gov/pubmed/22283971>
2. Tseng C-H. Lipoprotein(a) is an independent risk factor for peripheral arterial disease in Chinese type 2 diabetic patients in Taiwan. *Diabetes Care* [Internet]. 2004 Feb [cited 2019 Jan 27];27(2):517–21. Available from: <http://www.ncbi.nlm.nih.gov/pubmed/14747238>
3. Stein JH, Rosenson RS. Lipoprotein $Lp(a)$ excess and coronary heart disease. *Arch Intern Med* [Internet]. 1997 Jun 9 [cited 2019 Jan 27];157(11):1170–6. Available from: <http://www.ncbi.nlm.nih.gov/pubmed/9183227>
4. Watts GF, Mandalia S, Brunt JN, Slavin BM, Coltart DJ, Lewis B. Independent associations between plasma lipoprotein subfraction levels and the course of coronary artery disease in the St. Thomas' Atherosclerosis Regression Study (STARS). *Metabolism* [Internet]. 1993 Nov [cited 2019 Jan 27];42(11):1461–7. Available from: <http://www.ncbi.nlm.nih.gov/pubmed/8231842>
5. Funatsu H, Shinizu E, Noma H, Mimura T, Hori S. Association between serum lipoprotein (a) level and progression of non-proliferative diabetic retinopathy in Type 2 diabetes. *Acta Ophthalmol* [Internet]. 2009 Aug 1 [cited 2019 Jan 27];87(5):501–5. Available from: <http://doi.wiley.com/10.1111/j.1755-3768.2008.01298.x>
6. Deb A, Caplice MM. Lipoprotein(a): new insights into mechanisms of atherogenesis and thrombosis. *Clin Cardiol* [Internet]. 2004 May [cited 2019 Jan 27];27(5):258–64. Available from: <http://www.ncbi.nlm.nih.gov/pubmed/15188938>
7. Császár A, Dieplinger H, Sandholzer C, Karádi I, Juhász E, Drexel H, et al. Plasma lipoprotein (a) concentration and phenotypes in diabetes mellitus. *Diabetologia* [Internet]. 1993 Jan [cited 2019 Jan 27];36(1):47–51. Available from: <http://www.ncbi.nlm.nih.gov/pubmed/8436252>
8. Haffner SM, Morales PA, Stern MP, Gruber MK. $Lp(a)$ concentrations in NIDDM. *Diabetes* [Internet]. 1992 Oct [cited 2019 Jan 27]; 41(10):1267–72. Available from: <http://www.ncbi.nlm.nih.gov/pubmed/1397699>
9. Braunwald E, Bonow RO. Braunwald's heart disease: a textbook of cardiovascular medicine. Elsevier Saunders; 2012.

10. Kim EJ, Park CG, Park JS, Suh SY, Choi CU, Kim JW, et al. Relationship between blood pressure parameters and pulse wave velocity in normotensive and hypertensive subjects: invasive study. *J Hum Hypertens* [Internet]. 2007 Feb [cited 2019 Jan 27];21(2):141–8. Available from: <http://www.ncbi.nlm.nih.gov/pubmed/17136108>
11. Wakabayashi I, Masuda H. Lipoprotein (a) as a determinant of arterial stiffness in elderly patients with type 2 diabetes mellitus. *Clin Chim Acta* [Internet]. 2006 Nov [cited 2019 Jan 27];373(1–2):127–31. Available from: <http://www.ncbi.nlm.nih.gov/pubmed/16820145>
12. Nordestgaard BG, Chapman MJ, Ray K, Borén J, Andreotti F, Watts GF, et al. Lipoprotein(a) as a cardiovascular risk factor: current status. *Eur Heart J* [Internet]. 2010 Dec [cited 2019 Jan 27];31(23):2844–53. Available from: <http://www.ncbi.nlm.nih.gov/pubmed/20965889>
13. Motobe K, Tomiyama H, Koji Y, Yambe M, Gulinisa Z, Arai T, et al. Cut-off value of the ankle-brachial pressure index at which the accuracy of brachial-ankle pulse wave velocity measurement is diminished. *Circ J* [Internet]. 2005 Jan [cited 2019 Jan 27];69(1):55–60. Available from: <http://www.ncbi.nlm.nih.gov/pubmed/15635203>
14. Tsimikas S, Willerson JT, Ridker PM. C-Reactive Protein and Other Emerging Blood Biomarkers to Optimize Risk Stratification of Vulnerable Patients. *J Am Coll Cardiol* [Internet]. 2006 Apr 18 [cited 2019 Jan 27];47(8):C19–31. Available from: <http://www.ncbi.nlm.nih.gov/pubmed/16631506>
15. Momiyama Y, Ohmori R, Fayad ZA, Kihara T, Tanaka N, Kato R, et al. Associations between plasma osteopontin levels and the severities of coronary and aortic atherosclerosis. *Atherosclerosis* [Internet]. 2010 Jun [cited 2019 Jan 27];210(2):668–70. Available from: <http://www.ncbi.nlm.nih.gov/pubmed/20074733>
16. El-Gendi SS, Bakeet MY, El-Hamed EA, Ibrahim FK, Ahmed R. The value of lipoprotein (a), homocysteine, and Doppler of carotid and femoral arteries in assessment of atherosclerosis in asymptomatic cardiovascular risk patients. *J Cardiol* [Internet]. 2008 Dec [cited 2019 Jan 27];52(3):202–11. Available from: <http://www.ncbi.nlm.nih.gov/pubmed/19027598>
17. Riches K, Porter KE. Lipoprotein(a): Cellular Effects and Molecular Mechanisms. *Cholesterol* [Internet]. 2012 Sep 6 [cited 2019 Jan 27];2012:1–10. Available from: <http://www.ncbi.nlm.nih.gov/pubmed/22991657>
18. Hancock MA, Boffa MB, Marcovina SM, Nesheim ME, Koschinsky ML. Inhibition of Plasminogen Activation by Lipoprotein(a). *J Biol Chem* [Internet]. 2003 Jun 27 [cited 2019 Jan 27];278(26):23260–9. Available from: <http://www.ncbi.nlm.nih.gov/pubmed/12697748>
19. Kotani K, Yamada S, Yamada T, Kario K, Taniguchi N. Oxidized lipoprotein(a) and cardio-ankle vascular index (CAVI) in hypertensive subjects. *Heart Vessels* [Internet]. 2013 Jul 19 [cited 2019 Jan 27];28(4):461–6. Available from: <http://www.ncbi.nlm.nih.gov/pubmed/22710560>

LIPOPROTEIN (A) AND ARTERIAL STIFFNESS IN PATIENTS WITH DIABETES MELLITUS

ORIGINALITY REPORT

14%

SIMILARITY INDEX

9%

INTERNET SOURCES

12%

PUBLICATIONS

0%

STUDENT PAPERS

PRIMARY SOURCES

- 1** Wakabayashi, I.. "Lipoprotein (a) as a determinant of arterial stiffness in elderly patients with type 2 diabetes mellitus", *Clinica Chimica Acta*, 200611
Publication 1%
- 2** ueaeprints.uea.ac.uk
Internet Source 1%
- 3** Kristin S. Lange, Alexander H. Nave, Thomas G. Liman, Ulrike Grittner, Matthias Endres, Martin Ebinger. "Lipoprotein(a) Levels and Recurrent Vascular Events After First Ischemic Stroke", *Stroke*, 2017
Publication 1%
- 4** vasera.ru
Internet Source 1%
- 5** journal.unair.ac.id
Internet Source 1%
- 6** www.aerzteblatt.de
Internet Source 1%

| | | |
|----|---|-----|
| 7 | www.jove.com Internet Source | 1% |
| 8 | media.neliti.com Internet Source | 1% |
| 9 | Anandita Agarwala, Yashashwi Pokharel, Anum Saeed, Wensheng Sun et al. "The association of lipoprotein(a) with incident heart failure hospitalization: Atherosclerosis Risk in Communities study", <i>Atherosclerosis</i> , 2017 Publication | <1% |
| 10 | www.recentmedicalfindings.com Internet Source | <1% |
| 11 | Byung Yong Kang, Joon Seol Bae, Ki Tae Kim, Jae Hyoun Kim, Jung Hee Shin, Chung Choo Lee. "Apolipoprotein(a) Gene Polymorphism in the Korean Population: Is There Any Relevance to Essential Hypertension?", <i>Medical Principles and Practice</i> , 2002 Publication | <1% |
| 12 | orca.cf.ac.uk Internet Source | <1% |
| 13 | M. Alsaeid. "Angiotensin-converting enzyme gene polymorphism and lipid profiles in Kuwaiti children with type 1 diabetes", <i>Pediatric Diabetes</i> , 6/2004 Publication | <1% |

14

content.iospress.com

Internet Source

<1%

15

www.turkjem.org

Internet Source

<1%

16

Nirandeeep Rehill. "The effect of chronic tobacco smoking on arterial stiffness", British Journal of Clinical Pharmacology, 6/2006

Publication

<1%

17

K. -H. Song. "The effect of long-term glycaemic control on serum lipoprotein(a) levels in patients with Type 2 diabetes mellitus", Diabetic Medicine, 12/1999

Publication

<1%

18

edoc.ub.uni-muenchen.de

Internet Source

<1%

19

koreancircj.kr

Internet Source

<1%

20

Durrington, Paul N., Jonathan D. Schofield, Tarza Siahmansur, and Handrean Soran. "Lipoprotein (a) : gene genie", Current Opinion in Lipidology, 2014.

Publication

<1%

21

www.ncbi.nlm.nih.gov

Internet Source

<1%

22

A. Yasmin, A. Aryadi, A. Widya, A. P. Suwirya et

<1%

al. " Original ResearchHypertension in rural area: The determinants of left ventricular geometric alteration among hypertensive patients at Kubu Village, Karangasem, BaliEffectiveness comparison between lisinopril and amlodipine in Melanesian patients with hypertensionAn experimental study of β -D-Glucans extract of polysaccharide peptides as anti-inflammation and anti-oxidant in patients at high-risk of atherosclerosisEchocardiographic findings among hypertensive patients in rural area: The descriptive study at Kubu Village, Karangasem, BaliAddition of left ventricular ejection fraction to the GRACE score in prediction of short term prognosis in patients with non ST-elevation myocardial infarctionEffect of colchicine on HsCRP and mean platelet volume in acute myocardial infarctionCorrelation between GRACE score with spatial QRS-T angle in non-ST elevation myocardial infarction patientsPrevalence of Impaired Kidney Function in Hospitalized Hypertensive Patients in Agoesdjam General Hospital, Ketapang, West Borneo, IndonesiaInappropriate initial treatment in acute coronary syndrome patients: A gap in cardiovascular careCorrelation between plasma histamine level and atherosclerosis severity based on carotid intima media thickness (CIMT)

measurement in patients with stable coronary artery disease
Clinical characteristics, management and outcome of patients with ST elevation myocardial infarction in Pekanbaru city: Preliminary result of single center experience
Phase II cardiac rehabilitation program increases functional capacity in post atrial septal defect surgical closure in adult patients
The identification of human telomerase catalytic subunit in cervical cancer patients and its potential usage as strategy to reawaken hibernating myocardium post myocardial infarction
Could EURO heart risk score predict the severity of coronary lesion?
Pericardial effusion in systemic lupus erythematosus
Intracardiac metastasis of hepatocellular carcinoma
Myocardial bridging assessed by computed tomography scan: A cause of chest pain in patients without obstructed coronary arteries
Correlation between resting heart rate and 6-Minute Walk Test distance in systolic heart failure patients
Severe pulmonary hypertension is a predictor of mortality in pregnant unoperated atrial septal defect
High plasma level of soluble ST2 associated with adverse outcomes during acute phase of ST-elevation myocardial infarction
Effect of extracorporeal shockwave myocardial revascularization on spatial QRS – T

angle resolution in stable coronary artery disease patients
Fragmented QRS study, does it have any structural abnormality relation?
Risk of coronary artery lesions severity to erectile dysfunction incidence in stable coronary heart disease patients
Clinical profiles and outcomes of patients with ST-Elevation Acute Coronary Syndrome (STE-ACS) in non-primary PCI capable hospital
Correlation between QTc and QTcD with all caused in-hospital mortality after thrombolytic therapy in Dr. Moewardi Hospital, Surakarta
Functional capacity improvement after newly-modified cardiac rehabilitation programme in post-revascularized coronary artery disease patients
Acute heart failure and diabetes are predictors for mortality in 6 months follow up after acute coronary syndrome
Respiratory training as adjuvant of phase 2 exercise program decreased systolic pulmonary artery pressure in post mitral valve surgery patients with residual pulmonary hypertension
Correlation between Tricuspid Regurgitation Duration with Pulmonary Pressure in Heart Failure Patients
Compatibility of myocardial damage observed by echocardiography to MSCT coronary assessment of arterial stenosis in acute coronary syndrome
Hypolipidemic effect and antioxidant activity of (Tamarind) leaves in hypercholesterolemic-fed rats
Correlation

between pulmonary hypertension and functional tricuspid regurgitation in Cimacan General Hospital
Correlation knowledge and attitude regarding behaviour of controlling blood pressure in elderly hypertension patient in Manggar District
Correlation of lipid profile and high sensitivity C-reactive protein among young people
Increased in-hospital mortality associated with hyponatremia in acute heart failure patients
The association between different criteria of obesity to the severity of coronary artery lesion
Predictor postoperative arrhythmias after pediatric cardiac surgery using aortic cross clamp and cardiopulmonary bypass
Profile of hyperthyroid heart disease patients in National Cardiac Center Harapan Kita : A descriptive study
Effect of cardiac rehabilitation programs on functional capacity of post coronary revascularization patient with decrease ejection fraction using Six Minute Walk-Test
Association of postoperative hyperglycemia with in-hospital mortality in patients undergoing on pump coronary artery bypass grafting
A comparison successful reperfusion with and without fibrinolytic therapy in acute ST-segment elevation myocardial infarct patients
Factors influencing ventricular function in repaired (mid-term evaluation)
Correlation between tricuspid regurgitation duration with right ventricular

dysfunction in atrial septal defect patients
The effect of therapy
Spiritual Emotional Freedom Technique (SEFT) changes on blood pressure in elderly hypertension experience in Rejosari Karanganyo Trenggalek 2015
Hyponatremia as a predictor of rehospitalization in patients with acute decompensated heart failure
Effect of sildenafil therapy to functional capacity in congenital heart disease patient with severe pulmonary hypertension in Sardjito Hospital
Eisenmenger syndrome is more prevalence in young female patients with uncorrected atrial septal defect: Result of a single-center registry
Leuko-glycemic index as an in-hospital prognostic marker in patients with ST-segment elevation myocardial infarction in Haji Adam Malik General Hospital
Serum uric acid levels as predictors of incident complications in acute coronary syndrome
Anticoagulant therapy in heart failure patients with sinus rhythm
Epicardial fat thickness is related to the blood pressure response abnormalities in exercise stress testing
Remote ischemic conditioning prior to primary percutaneous coronary intervention: The effect on Six Minutes Walk Test distance and serum NT-ProBNP level
Correlation between urinary protein and vascular dysfunction before and after Delivery in

preeclamptic women
Impact of high hsCRP level on adverse cardiovascular events and mortality in ST-elevation acute myocardial infarction undergoing fibrinolysis
Correlation between baseline soluble ST2 and global longitudinal strain 2D Speckle tracking echocardiography with left ventricle remodeling post acute myocardial infarction
Difference of peripheral P level between univalvular and multivalvular of rheumatic heart disease
Correlation between the severity of hyperthyroidism with increased of systolic blood pressure in hyperthyroidism patients
Correlation of red cell distribution width with the severity of coronary artery disease in patients with stable coronary artery disease
Chest pain presentation on acute coronary syndrome patients in Dustira Hospital
Result of exercise stress testing after cardiac rehabilitation program after coronary artery bypass grafting surgery
Relationship between plasma level of Endothelin-1 with major adverse cardiac event in ST-elevation myocardial infarction undergoing percutaneous coronary intervention
Controlled clinic blood pressure lowers the risk of left ventricular hypertrophy: An internship study among hypertensive Indonesians in rural areas
Correlation of CHA₂DS₂-Vasc-HS scores with coronary artery lesions complexity based

on SYNTAX score
The correlation between body mass index and diastolic indices in non-diabetic hypertensive male subjects
Risk of traditional cardiovascular risk factor for the development of erectile dysfunction in stable coronary artery disease patients
Relationship between left ventricle ejection fraction and submaximal exercise capacity in cardiovascular patients
Relationship between type 2 diabetes mellitus with poor heart rate autonomic response in post acute myocardial infarction patients
The ECG features among hypertensive patients in rural area: A descriptive study at Kubu Village, Karangasem, Bali
Chronotropic incompetence in coronary artery bypass graft and heart valve surgery patients: The role of β -blocker
Correlation between fibrinogen and low density lipoprotein (LDL) cholesterol levels with acute myocardial infarction
Cardiac rehabilitation use among patients with coronary artery disease on July–December 2015 in Dr. Hasan Sadikin General Hospital Bandung
Differences of plasma histamine level between acute coronary syndrome and stable coronary artery disease patients
High Endothelin-1 plasma level gives a tendency toward increasing rate of in-hospital major adverse cardiovascular outcomes in ST-elevation myocardial infarction undergoing fibrinolysis
Correlation between serum p53 levels

and vascular age determined by carotid intima media thickness (CIMT) in patients with intermediate cardiovascular risk factor
Clinical significance of precordial ST segment depression on admission electrocardiogram in patients with acute inferior myocardial infarction
Postprocedural high sensitivity C-reactive protein and the risk of recurrent ischemic events after percutaneous coronary intervention in patients with stable angina pectoris
The messenger ribonucleic acid expression of B-type natriuretic peptide, natriuretic peptide receptor type-A and type-C in cardiomyocytes of obese population
The correlation between serum galectin-3 level with wall motion score index in patients with ST-segment elevation myocardial infarction
Risk factors of atrial fibrillation in patients with chronic heart failure
QT interval prolongation after non-ST elevation myocardial infarction in type 2 diabetic compared with nondiabetic patients
The novel effect of polysaccharide peptides of to endothelial dysfunction and dislipidemia in high risk groups of atherosclerosis
Relation of Left Atrial Spontaneous Echocardiographic Contrast to Neutrophil/Lymphocyte Ratio in Patient With Mitral Stenosis
Analysis of characteristic of atrial fibrillation versus not atrial fibrillation in hospitalized heart failure patients
Pulmonary

hypertension features in adult atrial septal defect
at RSUP Dr. Sardjito
The association between plasma tryptase with ventricular remodeling after 1 month in patients with acute coronary syndrome
The correlation of plasma histamine and tryptase with ST-elevation acute myocardial infarction in acute coronary syndrome patients
Acute kidney injury after coronary artery bypass graft surgery: Incidence and pre operative risk profile
The effect of diabetes mellitus on in-hospital mortality and major complications after isolated coronary artery bypass grafting surgery
Factor those influence return to work after CABG revascularization on coronary artery disease patients
The correlation of pulmonary vein endothelin-1 level with pulmonary vascular resistance before and after mitral valve surgery with pulmonary hypertension
Mitral valve E-Point septal separation as an independent predictor for in-hospital mortality after acute ST-elevation myocardial infarction
Effects of allopurinol on complications of post coronary artery bypass graft (CABG) surgery in coronary artery disease's patient with left ventricular dysfunction
Maternal and fetal outcomes of pregnancy with valvular heart disease
QRS duration in ST elevation myocardial infarction patients undergoing a primary percutaneous

intervention
Knowledge of resident medical officers on hypertensive emergency: A descriptive study
Hyperuricemia and its association with incident of congestive heart failure in Madurese population
Diagnostic value of Duke Treadmill Score in predicting coronary lesions severity in patients with suspected stable coronary artery diseases
Relationship of plasma glucose levels and troponin-I in patients wi...

Publication

23

Kubozono, Takuro, Masaaki Miyata, Kiyo Ueyama, Aya Nagaki, Yutaka Otsuji, Ken Kusano, Osamu Kubozono, and Chuwa Tei. "Clinical Significance and Reproducibility of New Arterial Distensibility Index", Circulation Journal, 2007.

Publication

<1%

24

link.springer.com

Internet Source

<1%

25

Ye, Z., P. C. Haycock, D. Gurdasani, C. Pomilla, S. M. Boekholdt, S. Tsimikas, K.-T. Khaw, N. J. Wareham, M. S. Sandhu, and N. G. Forouhi. "The association between circulating lipoprotein(a) and type 2 diabetes: is it causal?", Diabetes, 2013.

Publication

<1%

26

Park, Sang-Ho, Seung-Woon Rha, Byoung-Geol

<1%

Choi, Ji-Young Park, Woong Jeon, Hong-Seog Seo, Eung-Ju Kim, Jin-Oh Na, Cheol-Ung Choi, Jin-Won Kim, Hong-Euy Lim, Chang-Gyu Park, and Dong-Joo Oh. "Impact of High Lipoprotein(a) Levels on In-stent Restenosis and Long-Term Clinical Outcomes of Angina Pectoris Patients undergoing Percutaneous Coronary Intervention with Drug-eluting Stents in Asian population", *Clinical and Experimental Pharmacology and Physiology*, 2015.

Publication

27

Barth, J.D.. "Lipoproteins and the progression/regression of atherosclerosis", *Bailliere's Clinical Endocrinology and Metabolism*, 199510

<1%

Publication

28

Hiraokal, Jun, Yosikazu Nakamura, Hiroshi Yanagawa, and Naoki Nago. "Distribution of Lipoprotein (a) and Relationships between its Level and Blood Chemical Findings in a Rural Area in Japan", *Journal of Epidemiology*, 1994.

<1%

Publication

29

"Tuesday, 2 September 2008", *European Heart Journal*, 09/02/2008

<1%

Publication

Exclude quotes Off

Exclude matches Off

Exclude bibliography On