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The relationship between the decrease in Glomerulus Filtration Rate (GFR) and the increase in amount of coronary artery lesions on coronary heart disease patients in Sanglah General Hospital, Denpasar-Indonesia

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ABSTRACT

Coronary heart disease or coronary artery disease is caused by the atherosclerosis process in the coronary blood vessels. The high number of patients with this condition is significantly due to the influence of modern and all instant lifestyle. Among the factors suspected to be capable of influencing the increase in the number of coronary artery lesions in coronary heart patients is the Glomerulus Filtration Rate (GFR). This result is related to the high mortality and morbidity of coronary heart patients.

Aim: The purpose of this research is to determine the relationship between the decrease in glomerulus filtration rate (GFR), the disturbance variables (age, gender, hypertension history, diabetes mellitus history, smoking history) and the increase in the number of coronary artery lesions in Sanglah General Hospital.

Methods: This research is an analytical observational design with the cross-sectional design using secondary data from the medical records in Sanglah General Hospital Denpasar. This study attains 196 sample.

Results: A significant relationship is attained between GFR (<60 ml/ minute) and the increase in the total vessel score (p = 0.017) with an OR 2.47 (CI95% 1.014-6.041). Furthermore, there is a significant relationship between risky age (male >45, female >55) and the increase in total vessel score (p = 0.015) with an OR 3.54 (CI 95% 1.217-10.307). Diabetes mellitus and the increase in the total vessel score also shows a significant relationship (p = 0.016) with an OR 2.99 (CI 95% 1.189-7.539). While other risk factors such as gender, hypertension, and smoking have an insignificant relationship (p > 0.05). In the multivariate analysis, GFR (<60 ml/ minute) is a predictor of the vessel score (p=0,050) with an adjusted value of OR 1.86 (CI 95% 0.735-4.725). There are some other variables in which are significant predictors of the increase in vessel score. Risky age (male >45, female >55) (p=0,048) with an adjusted OR value of 3.08 (CI 95% 1.012- 9.407) and also diabetes mellitus (p=0.044) with an adjusted OR value of 2.65 (CI 95% 0.145-0.973) are those predictors.

Conclusion: Hence, it appears that GFR (<60 ml/ minute), risky age (male >45, female >55) and diabetes mellitus have a significant relationship with the increase in vessel score and are predictors of the increase in vessel score. While gender, hypertension, and smoking do not have significant relationships with the increase in the amount of vessel score.

Keywords: Glomerulus Filtration Rate (GFR), severity of coronary artery lesions, vessel score, coronary angiography

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INTRODUCTION

Coronary heart disease or coronary artery disease is related to the atherosclerosis process in the coronary blood vessels. This atherosclerosis process is the narrowing of the coronary blood vessel due to the deposits of fat and plaques. Typically, the arterial blood vessel walls are very soft and flexible, which allows blood to flow easily. The deposits of fats and plaque on the arterial blood vessel walls would cause the walls to be hardened and less flexible which results in the narrowing of the artery, and this can decrease or even stop the blood flow.[1]

The high number of people with this disease is mostly due to the influence of a modern and all instant lifestyle. The World Health Organization (WHO) reported there are 17.5 million people who died due to the cardiovascular disease in 2012, or 3 out of 10 deaths is estimated to be due to heart disease. Coronary heart disease contributes to the cause of death of more than half of the patients with cardiovascular disease. Data attained from the Basic Health Research (RISKESDAS) 2013 showed that coronary heart disease is in the seventh highest position of not contagious diseases in Indonesia. The prevalence of coronary heart disease increases with the increase in age 65-74 years old which is 2% lower than the age group of ≥75 years old. Based on diagnosis by doctors, the prevalence of coronary heart diseases in Indonesia in 2013 is 0.5% or estimated to be approximately 883,447 people. While based on the symptoms without physician

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diagnosis is 1.5% or estimated to be approximately 2,650,340 people. In Bali, according to physician diagnosis, the prevalence of coronary heart disease is 0.4% or estimated to be approximately 12,272 people. While based on the symptoms without doctors' diagnosis is 1.3% or estimated to be approximately 39,885 people.[2]

The increase in mortality and morbidity due to kidney disease is frequently due to coronary heart disease and vice versa that the mortality and morbidity of a critical coronary syndrome are influenced by the kidney, especially the glomerulus filtration rate (GFR).[3,4] Among the factors suspected to be capable of affecting the extent of coronary severity on coronary heart patients is the glomerulus filtration rate. This result is related to the high mortality and morbidity of coronary heart patients. Some studies show that there is a significant relationship between the decrease in glomerulus filtration rate and the increase in mortality of myocardial infarction patients. One of the research in Korea stated that 18.3% of the number of deaths of critical myocardial infarction patients have GFR <15 mL/ min/1.73m^2. On the other hand, the number of death of patients with GFR >90 mL/min/1.73m^2 is only 1.2%.[4] Additionally, the research conducted in Cipto Mangunkusumo Hospital Jakarta revealed that there is a significant relationship of the decrease in GFR <60mL/minute as the predictor of mortality with an OR of 2.97.[3]

The decrease in GFR is an indication of a vascular disorder, especially for the population with high risk. Patients with impaired renal functions have vasculopathy conditions which accelerate atherosclerosis and influence the extent of the post-critical coronary syndrome. Also, patients with impaired renal functions also have an increased inflammation indication (CRP, IL-6, ICAM-1) and pro-coagulant (D-dimer, fibrinogen) which are predictors of death risk and cardiovascular risk.[5]

METHOD

This research is analytic observational research with the cross-sectional study approach to identify the relationship between glomerulus filtration rate and the increase in the number of coronary artery lesions in Sanglah General Hospital. This research is conducted over 6 (six) months from July 2017 until December 2017 in the *Pelayanan Jantung Terpadu* (Integrated Heart Service) of Sanglah General Hospital. The criteria include all coronary heart patients who have undergone coronary angiography examinations and took in creatinine serum in Sanglah General Hospital with complete data. Complete data consists of (age, gender, blood pressure, diabetes mellitus history, smoking history, coronary angiography results and creatinine serum). If the data do not meet the criteria, it will be excluded from the research. This research is conducted using secondary data, namely the medical record data attained from Sanglah General Hospital. The medical record data which meet the criteria are included in the research sample, afterward coding, data tabulation and data entry into the computer are realized. Data is also displayed in the form of a table. Data analysis comprises of descriptive analysis which is conducted to explain the characteristics of each variable. Bivariate analysis using the Pearson-chi square test to examine the relationship between the independent variable, control variable, and the dependent variable by determining the odds ratio (OR), the confidence interval of 95% and the p-value. Afterwards, the multivariate analysis with the logistic regression test is conducted for the variables that have significant relationships with the vessel score to obtain the adjusted OR.

RESULTS

Sample Characteristics

During the research, data gathering is conducted from the medical record of coronary heart disease patients that have undergone catheterization and the creatinine serum examination in Sanglah General Hospital in 2016. From that 1 year, the total number of coronary heart disease patients is 196 people with demographical characteristics such as displayed in table 1.

In this research, it was revealed that there is a significant relationship between the decrease in renal function (GFR <60 ml/minute) and the increase in the number of coronary artery lesions, such as displayed in Table 2. Meanwhile, the relationship between vessel score or increment in the number of coronary artery lesions in Sanglah General Hospital with the confounding variables can be seen in Table 2. Afterwards, the multivariate analysis is conducted on the GFR variable and the confounding variables with a p-value <0.25 to attain adjusted OR for GFR and vessel score or the increase in the number of coronary artery lesions. The confounding variables included in the multivariate analysis are age and diabetes mellitus. The multivariate analysis results are shown in Table 3.

DISCUSSION

In this research, it seems that the OR for the GFR variable on the increase in vessel score or increase in the number of coronary artery lesions is 2,475 (CI 95% 1,014-6,041) (Table 2). The multivariate analysis for the GFR variable and the

Table 1 Research subject characteristics

	Total	
	n (196)	%
Age (mean ± SD)	58.1224 ± 8.92334	
Male >45 tahun, Female >55 tahun	176	89.8%
Male <45 tahun, Female <55 tahun	20	10.2%
Gender		
Male	171	87.2%
Female	25	12.8%
Hypertension		
Positive	110	56.1%
Negative	86	43.9%
Diabetes Mellitus		
Positive	99	50.5%
Negative	97	49.5%
Smoking		
Positive	7	3.6%
Negative	189	96.4%
GFR		
>60 ml/minute	96	49%
<60 ml/minute	100	51%
Vessel Score		
Single Vessel Disease*	25	12.8%
Multiple Vessel Disease*	171	87.2%

*Single Vessel Disease = <2 stenosis coronary blood vessel, Multiple Vessel Disease = >2 stenosis coronary blood vessel

confounding variable with a p-value of <0,25 is conducted to attain the adjusted OR of GFR on the increase in vessel score or increase in the number of coronary artery lesions. After conducting adjustments on other potential variables which statistically influence the increment in vessel score or increase in the number of coronary artery lesions, namely age and diabetes mellitus, an adjusted OR of 1,863 (CI 95% 1,735-4,725) is attained. This result shows that GFR (<60 ml/minute) is an independent predictor of the increase in vessel score or increase in the number of coronary artery lesions on coronary heart patients in Sanglah General Hospital. This is applicable not only for patients with severe renal function impairment but is also applicable for patients with moderate renal function impairment. This result is in line with the research in Japan which shows that GFR (<60 ml/minute) is a strong predictor of the increase in the number of coronary artery lesions on coronary heart patients in Japan.[6]

The decrease in renal function (decrease in GFR) is the residual of the confounding risk factors of the coronary heart disease. Patients with a reduction in GFR have a higher prevalence of coronary heart disease risk factor, such as diabetes mellitus, hypertension, and dyslipidemia. The example of a patient who had a decrease in GFR probably has suffered more severe hypertension or diabetes mellitus which caused more and severe vascular damage.[3,4,6]

The reduction in renal function (decrease in GFR) is the indication of vascular disorder especially for the population with high risk. On patients

Table 2 Bivariate analysis on the relationship of GFR and each risk factor on the increase in vessel score

		Vessel Score						CI 95%	
		Single		Multiple					
		n	%	n	%	p	OR	Lower	Upper
GFR	≥60 ml/minute	17	68.0%	79	46.2%	0.017*	2.475	1.014	6.041
	<60 ml/minute	8	32.0%	92	53.8%				
Age	Male ≥45, Female ≥55	19	76.0%	157	91.8%	0.015*	3.541	1.217	10.307
	Male <45, Female <55	6	24.0%	14	8.2%				
Gender	Male	23	92.0%	148	86.5%	0.445	0.560	0.124	2.533
	Female	2	8.0%	23	13.5%				
Hypertension	Positive	12	48.0%	98	57.3%	1.454	0.688	0.627	3.372
	Negative	13	52.0%	73	42.7%				
Diabetes Mellitus	Positive	7	28.0%	92	53.8%	0.016*	2.995	1.189	7.539
	Negative	18	72.0%	79	46.2%				
Smoking	Positive	1	4.0%	6	3.5%	0.902	0.873	0.101	7.567
	Negative	24	96.0%	165	96.5%				

*Chi-square test, significant if p <0.05

Table 3 **Multivariate analysis of the variables that have statistically significant relationship and have influence on the increase in vessel score**

Variable	p	adjusted OR	CI 95%	
			Lower	Upper
GFR	0.050*	1.863	1.735	4.725
Age	0.048*	3.085	1.012	9.407
Diabetes Mellitus	0.044*	2.659	1.028	6.879

*Regression logistic test

with a reduction in GFR, an increase in the indication of inflammation (CRP, IL-6, ICAM-1) occurs, and pro-coagulation (D-dimer, fibrinogen) which is the death predictors for coronary heart patients.[5] Coronary heart patients with a decrease in GFR <60 ml/minute also have correlations to the death rate with an average of 20% mainly on stage V. This is consistent with the findings in a research conducted in Cipto Mangunkusumo General Hospital Jakarta which shows there is a significant correlation of the decrease in GFR <60 ml/minute as the predictor of mortality with an OR of 2.97.[3]

The Relationship between Other Variables that Influence the Increase in Coronary Artery Lesions in Sanglah General Hospital

In this research, some other variables are significant and are predictors of the increase in coronary artery lesions or increase in vessel score, namely age and diabetes mellitus. Risky age (Male >45, Female >55) is shown to have an OR 3.541 (CI 95% 1.217-10.307) and an adjusted OR 3.085 (CI 95% 1.012-9.407). Meanwhile, diabetes mellitus has an OR of 2.99 (CI 95% 1.189-7.539) and adjusted OR of 2.65 (CI 95% 0.145-0.973).

In a research in Korea, different results were attained, in which age does not have a relationship with the increase in total vessel score (p = 0.143).[6] The difference in data measure method causes this condition, forage the mean value which is connected to the vessel score is used, while in this research age is categorized as risky age and non-risky age. In literature, it is stated that the older the age, the lower the physiological functions of the body.

Other variables that are significant on the increase in the number of coronary artery lesions or increase in vessel score is diabetes mellitus. In a study conducted in Semarang, similar results were attained, from all risk factors for coronary heart disease; only diabetes mellitus correlates with the increase in total vessel score or coronary artery lesion (p = 0.47).[7] In the research in Korea, it was stated that there is no significant relationship between diabetes mellitus and the increase in total vessel score (p = 0.223).[6] This is probably due to the population of patients with diabetes mellitus (15.3%) is much lower than the population of patients with no diabetes mellitus (84.7%).[6]

In this research, some variables are initially suspected to influence the increase in the number of coronary artery lesions or increase in vessel score but was proved to be not statistically significant, namely hypertension, gender, and smoking. In a research conducted in Haji Adam Malik Hospital Medan, hypertension has a relationship with the increase in total vessel score.[7] The difference in result is due to the difference in research design, namely case control. Theoretically, hypertension can increase the risk of cardiovascular disease occurrence. This is because in hypertension patients usually there are already some risk factors, afterward high blood pressure which causes high stretch power can injure the arterial endothelium. Repeated injury may cause inflammation and the occurrence of atherosclerosis.

Meanwhile, in this research, gender shows a significant difference between male 71 (87.2%) and female 25 (12.8%). The coronary heart patients mostly consist of male (Table 1), while in Table 2, gender does not show any significant relationship with the increase in total vessel score or increase in the number of coronary artery lesions (p = 0.445). According to American Heart Association (AHA), it was explained that the morbidity of coronary heart disease for males is greater than for females. This is because the estrogen has a protective characteristic on women but after menopause disease morbidity.[8]

This research also shows that smoking does not influence the increase in total vessel score or increase in the number of coronary artery lesions. Similar results are also found on research in Japan (p= 0.648) and Korea (p = 0.566), in which smoking does not have any relationship with the increase in total vessel score or increase in the amount of coronary artery lesion.[6,9] Smoking is a risk factor for the occurrence of coronary heart diseases due to the elevation of monoxide level and release of catecholamine which causes vasoconstriction and the occurrence of platelet adhesion.

LIMITATIONS

The limitations of this research are that it did not examine the relationship of other risk factors, such as cholesterol level and stress, in which are risk factors that can be changed on coronary heart disease patients due to the limited information available. Furthermore, information regarding risk factors or confounding factors are often forgotten by the research subjects or are not recorded in the medical records *(recall bias)* such as smoking history which is frequently not filled in and hypertension that has already been controlled.

CONFLICT OF INTERESTS

Author states that there is no conflict of interest with regard to the study.

CONCLUSION

Thus, it can be concluded that the decrease in GFR <60 ml/minute, risky age, and diabetes mellitus have a significant relationship with the increase in total vessel score or the increase in the number of coronary artery lesions, and are also the increment predictors in total vessel score or the increase in the amount of coronary artery lesion. While gender, hypertension, and smoking do not have any significant relationship.

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