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Analysis of Serum Creatinine Level and Contrast Volume in Contrast Induced Nephrophaty Incidence after Percutaneus Coronary Intervention

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Abstract

The increase of percutaneous coronary intervention (PCI) in cardiovascular patients through the administration of contrast agents leads to a potential risk of contrast induced nephrophaty (CIN) incidence. This study aims to analyze the particular level of serum creatinine through the administration of contrast agents and specific contrast volumes in CIN incidence after PCI. The experimental design used in this study was cross sectional design. The total samples were 30 patients who underwent percutaneus coronary intervention (PCI) at the Cardiovascular Center Unit of Dr. Wahidin Sudirohusodo Hospital in Makassar Municipality.

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The statistical test used to analyze serum creatinine levels before and after PCI was Mann-Whitney U test and contrast volumes were compared based on results of the analysis of serum creatinine levels. Results of the analysis of serum creatinine levels after PCI indicated that 10 patients (33.33%) experienced CIN incidence and their serum creatinine levels were higher than other remaining patients at the normal level of serum creatinine. The increase of serum creatinine levels before and after PCI showed statistically significant difference between the CIN group and the non-CIN group. On average, administration of contrast volumes at >50 mL and frequency of CIN incidence was found in diagnosed patients who experienced the coronary artery disease (CAD) at both grade 1 and 3. Results of this study proved that PCI increased potential risk of CIN incidence and provided a novel data to be used for the elucidation in subsequent health studies, in which contrast volume at <50 mL and diagnosis of the various grades of CAD could be used as a sustainable consideration for the administration of contrast agents.

Keywords: Percutaneus Coronary Intervention (PCI; Contrast Induced Nephrophaty (CIN); Serum Creatinine,; Contrast Volume.

1. Introduction

Percutaneous coronary infection (PCI) in patients due to intravenously administration of contrast agents that contain iodine shows an ascending prevalence in medicine cases and it has been estimated that more than of 80 million of contrast doses (8 million liters)/year were administered to patients worldwide. One of the serious health complications due to administration of contrast agents is contrast induced acute kidney injury (CI-AKI) or commonly known as contrast induced nephrophaty (CIN). Contrast induced nephropathy has become the third leading cause (11%) of acute kidney injury (AKI) in hospitals after hipotension and operation [1-3].

Contrast induced nephropaty (CIN) is a serious health concern that relates with the uprising of morbidity and mortality cases, particularly among patients in the high risk category after coronary angiography and/or percutaneous coronary intervention. CIN incidence is a common health case in general populations with the prevalence level achieves approximately only at 0,6-2,3%, but prevalence of CIN incidence increases at $\geq$ 50% among populations of patients with renal failure, diabetes melitus, and cardiovascular impairment [4-5].

Renal perfusion and toxic effects in tubular cells of renal organs due to both direct and indirect effects of administration of contrast agents are commonly approved in experimental studies as the important causal mechanism for CIN incidence. In addition to that, exposure of contrast agents at high volume leads to the imbalance as shown in the rise of renal vasoconstriction and reduction of vasodilatation. This adverse condition causes reduction of renal blood flow, contraction of afferent artiorole that has a specific function to supply blood for glomerulus, renal ischemia and cellular necrosis. Oxygen radicals released by ischemia-reperfusion are not only lead to the impairment of renal function, but also causing apotosis of renal tubular epithelial cells. In most experimental studies, CIN is usually defined as impairment of renal function occurring within 24 hours to 72 hours after intravenously administration of contrast agents without considering its association with any causal factors. This adverse condition is commonly manifested in the reduction of temporal renal function, asymptomatic, and non-oliguria [6-7].

Concerning to the problem background stated above, this study aims to assess particular serum creatinine levels after percutaneous coronary intervention (PCI) to analyze the potential risk of CIN incidence due to PCI among patients at Dr. Wahidin Sudirohusodo Hospital, Makassar Municipality. Results of analysis in this study are hoped to provide a significant scientific contribution for the diagnosis of potential risk of CIN incidence among patients after percutaneous coronary intervention (PCI).

2. Materials and Methods

Samples analyzed in this study were derived from the Clinical Pathology and Medical Laboratory and the Internal Ward of Dr. Wahidin Sudirohusodo Hospital, Makassar Municipality, Indonesia. Analysis of serum creatinine levels was conducted at the Clinical Pathology and Medical Laboratory of Hasanuddin University by collecting the concentration of serum creatinine at 5 ml per patient.

Population and samples of this study were all patients who underwent percutaneus coronary intervention (PCI) that referred to the inclusion criteria at the Clinical Pathology and Medical Laboratory of Dr. Wahidin Sudirohusodo Hospital in Makassar Municipality. The total samples were 30 patients. The method used to collect samples as the subject of this study was consecutive sampling method. Each patient who fulfilled the inclusion criteria was included in this study by determining the admission of patients in a particular period of time until minimal number of patients fulfilled the criteria of sampling.

The inclusion criteria in this study were administration of contrast agents to patients according to their willingness to be participants in this study by signed the informed concent. Conversely, exclusion criteria in this study were patients who had high level of serum before administration of contrast media and patients were in the category of hemolytic, lipemic or icteric condition.

The parameter to examine whether a patient experienced CIN or not based on the ascending level of serum creatinine at $\geq$ 0.5 mg/dl or the 25% rise of baseline within 24-48 hours after PCI. The method used to analyze levels of serum creatinine was calorimetric method and concentration levels of serum ceretinine were counted using the *spectrophotometer* ABX Pentra 400^{R}. The referral values for the male group and the female group were 0,6-1,3 mg/dl and 0,5-1,0 mg/dl respectively. Administration of contrast media used low osmolality contrast media (LOCM) through intravenously injection to the body. All patients injected with media agents underwent coronary angiography and percutaneus coronary intervention at the Cardiovascular Center Unit of Dr. Wahidin Sudirohusodo Hospital.

3. Result

After PCI or contrast media administration and measurement of serum creatinine levels, results of the analysis indicated that 10 patients experienced CIN incidence, whereas, 20 respondents did not experience CIN incidence. Data of baseline characteristics of the study samples showed that both the CIN group and the non-CIN group did not show statistically significant difference in terms of mean age (p= 1,000). Additionally, both the CIN group and the non-CIN group did not prove statistically significant difference in terms of gender, body mass index, coronary artery disease (CAD) grading, contrast volume and smoking habits (p>0,05) respectively

(Table 1).

Table 1: Baseline Characteristics of Samples for both the CIN and the non-CIN groups.

Characteristics		**Groups**		***p***
		Non-CIN (n=20)	**CIN (n=10)**	
Age	< 60 years	12(60)	6(60)	1,000[+]
	≥ 60 years	8(40)	4(40)	
Gender	Male	17(85)	9(90)	1,000[+]
	Female	3 (15)	1(10)	
Diagnosis	CAD 1	12(60)	4(40)	0,116*
	CAD 2	5(25)	1(10)	
	CAD 3	3(15)	5(50)	
Complication	Diabetes mellitus	1(10)	6(60)	0,007*
	Hypertension	8(80)	8(80)	0,760*
	Hyperkolesterolemia	1(5)	1(10)	1,000*
	Acute Myocardial Infarction (AMI)	6(30)	2(20)	0,662*
	Congestive Heart Failure (CHF)	2(10)	2(20)	0,584*
Smoking habits		16(80)	7(70)	0,657*

Note: n = number of samples, BMI= body mass index, CAD = coronary artery disease

*: *Chi-square test; [+] = Fisher exact test.*

Diabetes mellitus (DM) complication showed statistically significant difference between the two groups (p<0,01), in which diabetic complication was higher in the CIN group (60%) than the non-CIN group (10%). Values of statistical distribution for hypertension, dyslipidemia and congestive heart failure (CHF) did not show statistically significant difference between the two groups (p>0,05) (Table 1).

Table 2: Analysis of Concentration Levels of Serum Creatinine Before and After the Administration of Contrast Agents (mg/dl).

Administration of Creatinine (mg/dl)	Non-CIN (n=20)	CIN (n=10)	Mean Difference	*P*
Pre-treatment	1,02+0,20	1,29+0,04	0.27	0,000[#]
Post-treatment	0,96+0,16	2,02+0,23	1.06	0,000[#]

[#] Mann-Whitney test

Mean concentration of serum creatinine after administration of contrast agents showed statistically significant difference between the CIN group and non-CIN group (p=0,000) in which mean concentration of serum creatinine in the CIN group (2,02 mg/dl) was higher than the non-CIN group (0,96 mg/dl) (Table 2).

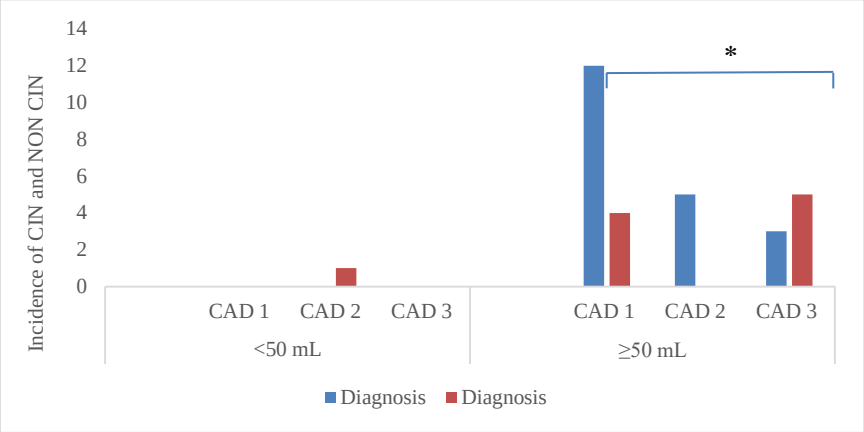

Figure 1: Statistical association between contrast induced nephropaty (CIN) incidence and the grades of coronary artery disease (CAD) based on administration of the various contrast volume levels after percutaneus coronary intervention (PCI) among the study patients.

**Chi Square Statistical Test showed difference between group diagnosed as Non CIN with CIN*

Data in Figure 1 indicated that administration of contrast volume at ≥50 showed significant difference of CIN incidence in most patients based on administration of different contrast volumes. All patients with CAD at the grade 2 experienced CIN incidence after administration of contrast volumes at <50 mL, whereas, all patients who had CAD at the grade 1 and 3 experienced CIN incidence after administration of contrast volumes at ≥50 mL. It was indicated that the highest CIN incidence occurred among patients who had CAD at the grade 3 with the contrast volume of ≥50 mL.

4. Discussion

Concentration levels of serum ceratinine of patients in the CIN group indicated a statistically significant rise. Accordingly, the finding of this study calls for health scientists to seek a technological innovation to reduce the potential risk of renal failure due to adverse effects of medical intervention and can be applied in health service institutions. This study is consistent with the previous studies on the adverse effect of PCI on renal function.

Both cardiovascular disease and renal disease are synergistically increase the risk of mortality and the two diseases are endemic in the current time [8-10]. The increase of serum creatinine concentration is correlated with myocardial flow failure and poor prognosis in patients who experience ST-elevation myocardial infarction (STEMI) after PCI. CIN incidence in cardiovascular patients tends leads to poor prognostic [11-12].

Some studies deliver evidences that CIN incidence increases along with the administration of higher level of contrast agents, and even some scientific health articles have discussed the particular methods to prevent CIN

incidence through the administration of contrast agents at low volume and intake of supplements before conducting PCI [13-14]. Such health evidences might instigate further studies to precisely formulate and find health strategies to prevent CIN incidence as the potential risk of medical intervention.

A recent study reported that potential risk of CIN incidence or renal failure and other adverse effects due to contrast media could be reduced by diminishing osmolality [15-17]. High volume of medium contrast at 272 mL is recommended to be used as the predictor of CIN incidence and it is suggested to reduce contrast volume in order to be able to protect the potential impairment of kidneys [18-20].

Indeed, this study did not propose a standardized cutoff of contrast volume administration, nevertheless, it suggested administration of contrast agents with low volume at <50 mL and diagnosis of CAD grades that could be used as a sustainable consideration for the administration of contrast agents.

5. Conclusion

Results of this study proved that PCI increased potential risk of CIN incidence and provided a novel data to be used for the elucidation in subsequent health studies, in which contrast volume at <50 mL and diagnosis of the various grades of CAD could be used as a sustainable consideration for the administration of contrast agents.

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6. Competing Interest

The authors declare that they have no competing interests.

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