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Risk Factors of Contrast-Induced Nephropathy in Patients Undergoing Coronary Intervention Procedures

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A B S T R A C T

Introduction: Coronary intervention (coronary angiography and percutaneous coronary intervention) is a medical procedure that uses significant amounts of contrast, which can lead to an increased incidence of contrast-induced nephropathy (CIN). This study aimed to determine the risk factors for contrast-induced nephropathy in patients undergoing coronary intervention procedures at Dr. M. Djamil General Hospital, Padang, Indonesia. **Methods:** This study is a cross-sectional analytic observational study. A total of 100 research subjects participated in this study. Univariate analysis of the frequency distribution was performed on the variable test. Bivariate analysis was performed to determine the risk factors associated with CIN in patients undergoing coronary intervention procedures, $p<0.05$. **Results:** The results of the study showed that contrast volume ≥ 100 ml was associated with the incidence of CIN, $p<0.05$. In addition, serum creatinine level > 1.5 mg/dL was associated with the incidence of CIN, $p<0.05$. **Conclusion:** Contrast volume ≥ 100 ml and serum creatinine level > 1.5 mg/dl increase the risk of contrast-induced nephropathy in patients undergoing coronary intervention procedures at Dr. M. Djamil General Hospital, Padang, Indonesia.

1. Introduction

Along with the development of modern medical technology, the use of contrast as a diagnostic and therapeutic tool is very common throughout the world. This resulted in an incident occurring contrast-induced nephropathy (CIN) increasing. Coronary intervention (coronary angiography and percutaneous coronary intervention) is a medical procedure that uses significant amounts of contrast, which can lead to an increased incidence of contrast-induced nephropathy (CIN). Acute kidney injury (AKI) often occurs after cardiac catheterization or percutaneous coronary intervention (PCI) with an incidence variability of more than 5 times**.** Patients who experience AKI can increase the risk of death in the short and long term and can also affect the progressivity of kidney illness.[1-4]

Contrast-induced nephropathy (CIN) is a manifestation of acute kidney injury (AKI) that occurs after exposure to intravascular contrast media. The pathogenesis involved renal ischemia, particularly in the medullary region, where oxygen delivery is already at low levels, as well as a direct toxic effect on epithelial cells. Until now, there is no consensus that officially outlines the definition of CIN-AKI. Contrast Induced Nephropathy usually defined as an acute decrease in renal function (25% increase in serum creatinine) within 48 hours after exposure to the contrast

medium. One of the main steps to reduce the risk of developing CIN is to identify patients who are at risk and initiate prophylactic measures in patients at 50% or greater risk.[5-9] This study aimed to determine the risk factors for contrast-induced nephropathy in patients undergoing coronary intervention procedures at Dr. M. Djamil General Hospital, Padang, Indonesia.

2. Methods

This study was a cross-sectional analytic observational study and used primary data from clinical observations of research subjects. A total of 100 research subjects participated in this study, and the research subjects met the inclusion criteria. The inclusion criteria in this study were patients who went to the cardiac and vascular polyclinic at Dr. M Djamil General Hospital, Padang, Indonesia, over 18 years old, have no history of kidney problems, and are willing to participate in this study as indicated by signing an informed consent form. This study has got the approval of the medical and health research ethics committee at Dr. M Djamil General Hospital, Padang, Indonesia.

This study observed sociodemographic, clinical, and laboratory data on research subjects. Observation of age, sex, body weight, history of diabetes mellitus, type of procedure, the volume of contrast, as well as technical laboratory tests for standard analysis was carried out by examining hemoglobin levels expressed in units of g/dl, BUN levels in units of mg/dl and creatinine in units of mg/dl. Contrast-induced nephropathy (CIN) was defined as an increase of more than or equal to 25% or equal to 0.5 mg/dl of serum creatinine before the procedure using contrast. Data analysis was carried out using SPSS software version 21. Univariate analysis of the frequency distribution was performed on the variable test. Bivariate analysis was performed to determine the risk factors associated with CIN in patients undergoing coronary intervention procedures, $p<0.05$.

3. Results and Discussion

Table 1 presents the relationship between risk factors for CIN. The results of the study showed that contrast volume ≥ 100 ml was associated with the incidence of CIN, $p<0.05$. In addition, serum creatinine level > 1.5 mg/dL was associated with the incidence of CIN, $p<0.05$.

Table 1. Relationship of risk factors to CIN.

Variable	Frequency (%)	Not CIN	CIN	p-value*
Age > 75 years	16 (16)	6	2	0,464
Male	74 (74)	66	8	0,254
Diabetes	48 (48)	42	6	0,547
Anemia	24 (24)	18	6	0,21
Hemoglobin < 12 mg/dL	32 (32)	24	8	0,136
eGFR <60 ml/min/1,73 mm^2	70 (70)	56	14	0,067
Contrast volume ≥100 ml	18 (18)	10	8	0,015
BUN > 24 mg/dl	28 (28)	20	8	0,085
Creatinine serum >1.5 mg/dL	40 (40)	26	14	0,001

*Chi-square test or Fischer Test, p=0,05.

Table 2 presents the prevalence ratio of the test variable. Contrast volume ≥ 100 ml has a risk of causing CIN events of 6.074 times. Meanwhile, serum creatinine levels > 1.5 mg/dl have 1.53 times the risk of causing CIN.

Table 2. Prevalence ratio of test variables.

Variable	PR (95%CI)
Contrast volume ≥100 ml	6,074 (1,64-22,54)
Serum creatinine >1.5 mg/dl	1,53 (1,11-2,12)

In this study, it was found that serum creatinine levels of more than 1.5 mg/dl had a statistically significant relationship with the incidence of CIN. This is in accordance with the research that has been done before. Another study compared the incidence of CIN in 206 patients undergoing coronary angiography procedures and found that 30.5% of patients with a baseline creatinine of more than 1.5 mg/dl experience CIN and as much as 25% experience an increase in creatinine from the initial creatinine level. Other research confirmed that there was no increased risk for patients with a baseline serum creatinine <1.5 mg/dL. We found a significantly increased risk of AKI following intravenous contrast administration for patients with an initial serum creatinine >1.5 mg/dL, which further increases with higher baseline creatinine levels. In a study involving 439 patients who underwent a PCI procedure and had a preoperative creatinine level of more than 1.8 mg/dl, one in three percent had CIN. Where the higher the patient's baseline creatine, the greater the risk of developing CIN, even though previously, prevention had been carried out with hydration and the use of non-ionic contrast.[10-14]

The greater the amount of contrast can affect the incidence of CIN. So many studies are trying to find a safe limit for the volume of contrast used. Previous research used a 65 ml contrast cut-off point. The results of this study showed that a higher contrast volume experienced an increase in serum creatinine levels within 48 hours after the procedure. Other studies suggest that CIN tends to occur at volumes of contrast higher than 100 ml. If the contrast is used more than 5 ml/kg body weight, then the incidence of CIN can increase significantly. In this study, referring to the Mehran scoring system, each use of 100 mL of contrast adds 1 point to the score. Patients who receive an amount of contrast of more than 100 mL will have an increased likelihood of experiencing CIN, the need for dialysis, and even permanent kidney damage. Baseline high creatinine coupled with large contrast volumes is associated with worse CIN outcomes and even death.[15-17]

4. Conclusion

Contrast volume ≥ 100 ml and serum creatinine level > 1.5 mg/dl increase the risk of contrast-induced nephropathy in patients undergoing coronary intervention procedures at Dr. M Djamil General Hospital, Padang, Indonesia.

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