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COMPARISON OF ADVANCIS SCORES, CIN-RISK, AND NATIONAL CARDIOVASCULAR DATA REGISTRY (NCDR) DATA AS A PREDICTOR OF ACUTE KIDNEY INJURY (AKI) IN ST-ELEVATION MYOCARDIAL INFARCTION (STEMI) PATIENTS UNDERGOING PRIMARY PERCUTANEOUS CORONARY INTERVENTION (PCI)

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Abstract

Background: Acute coronary syndrome (ACS) is one of the main problems in the cardiovascular. Acute kidney injury (AKI) is a common complication of critical illness, including acute coronary syndrome. Many factors contribute to the occurrence of AKI in acute myocardial infarction (AMI). The clinical tools for predicting the risk of AKI after AMI have not been available. This study compared the ADVANCIS, CIN-risk, and Cath-PCI National Cardiovascular Data Registry (NCDR) scores in predicting the incidence of AKI in ST-elevation myocardial infarction (STEMI) patients undergoing primary percutaneous coronary intervention (PCI).

Methods: This cohort study involved 72 STEMI patients who underwent primary PCI at H. Adam Malik General Hospital Medan from October 2018-October 2019. Variables such as risk factors for coronary heart disease, clinical parameters and laboratory values at admission and evaluation of creatinine levels were examined 48-72 hours after primary PCI. Statistical analysis was performed to assess the ability of these scores to predict the incidence of AKI in STEMI patients undergoing primary PCI.

Results: Among 72 patients, there were 25 patients (34.7%) who developed AKI and 47 patients did not develop AKI (65.3%). From these three scores studied, the highest area under curve (AUC) is CIN-risk score, which is 0.806 (95% CI: 0.695-0.916), followed by ADVANCIS score 0.771 (95% CI: 0.644-0.898), and NCDR score is 0.769 (95% CI: 0.648-0.889).

Conclusion: ADVANCIS, CIN-risk, and NCDR scores can be used to predict the incidence of AKI in STEMI patients undergoing primary PCI with CIN-risk scores having the best values as predictors.

Keywords: acute myocard infarct, acute kidney injury, ADVANCIS, CIN-risk, NCDR, percutaneous coronary intervention.

Introduction

ST-elevation myocardial infarction (STEMI) is still the leading cause of death in the world. The Global Registry of Acute Coronary Events (GRACE) study in 2001 showed the incidence of STEMI was as much as 27% of all sufferers of acute myocardial infarction (AMI). IMAEST patient mortality is influenced by various factors, including age, Killip class, duration of treatment, the presence of an emergency medical system based on the STEMI network, treatment strategies, history of AMI, diabetes mellitus, kidney failure, number of coronary arteries involved, and ejection of left ventricular fraction.[1]

The functions of the heart and kidneys are interrelated and inseparable. The relationship between the heart and kidneys occurs in various stages, including the sympathetic nervous system, the renin-angiotensin-aldosterone system (RAS system), antidiuretic hormones, endothelin, and natriuretic peptides. Acute kidney injury (AKI) is a common complication of critical illness, including acute coronary syndrome. AKI is a complex disorder

characterized by early deterioration of renal function (in hours or days) with clinical manifestations ranging from minimal increase in serum creatinine to renal failure requiring renal replacement therapy.[2]

Deterioration of renal function in STEMI patients is a strong independent predictor of mortality during treatment and 1 year after it[3]. Many factors contribute to the occurrence of AKI in AMI including hemodynamic disorders due to decreased cardiac output, contrast media exposure, neurohormonal activation, inflammation, oxidative stress, bleeding, acidosis, and hyperglycemia[4]. In addition, percutaneous intervention (PCI) and the use of intra-aortic balloon pumps (IABP) expose patients to ateroembolism. Various drugs such as diuretics, angiotensin-converting enzyme inhibitors (ACE-i), angiotensin II receptor blockers (ARB), antibiotics, and vasopressors can also worsen kidney disorders.[5]

The purpose of this study was to analyze the ability of ADVANCIS, CIN-risk, and NCDR scores to predict the incidence of acute kidney injury (AKI) in acute myocardial infarction patients with STEMI who had undergone primary PCI.

Methods

This is a cohort study to compare the ability of the ADVANCIS score system, the CIN-risk score, and the NCDR score in predicting the incidence of AKI in STEMI patients undergoing primary PCI in Haji Adam Malik General Hospital. The study was conducted in patients with acute myocardial infarction with STEMI who had undergone primary PCI at Haji Adam Malik General Hospital Medan from October 2018 to October 2019. Inclusion criteria were subjects diagnosed with STEMI and underwent primary PCI during the treatment period; willing to check serum creatinine levels at hospital admission and 48-72 hours after PCI. Exclusion criteria were patients diagnosed with late stage kidney disease who needed long-term dialysis.

All patients who met the inclusion criteria were asked for approval after an explanation of the purpose of the study and the procedure of action. This study was approved by the Health Ethics Committee of the Faculty of Medicine, University of North Sumatra and the Health Ethics Committee at Haji Adam Malik General Hospital. Researchers examined patients by taking anamnesis, physical examination, electrocardiography (ECG), and laboratory examinations when the patient came to the emergency department. The diagnosis of STEMI is made based on ESC criteria in 2017 and PERKI guidelines in 2015[6,7]. Researchers examined patient data during treatment on medical records to obtain data about patient profiles, risk factors, ECG examinations, and laboratory examinations.

Laboratory tests are performed when the patient enters the ER through the Clinical Pathology laboratory of the Haji Adam Malik General Hospital Medan. Then percutaneous coronary intervention was performed as a treatment for STEMI patients. Laboratory examinations was repeated 48-72 hours after PCI.

Patients who met the inclusion and exclusion criteria were then assessed the risk stratification score, namely the ADVANCIS, CIN-risk, and NCDR scores. Patients are treated according to the guidelines and clinical policies of the doctor who treats the patient. Data obtained from these observations will then be carried out statistical analysis using statistical programs to test the research hypotheses and achieve the objectives of the study.

Processing and analysis of statistical data using statistical computer programs. Categorical variables are represented by the number or frequency (n) and percentage (%). Numeric variables are represented by the mean center size measure and the standard deviation distribution size for normally distributed data. While the data that is not normally distributed is presented in the form of a median. Numerical variable normality test on all research subjects using one sample Kolmogorov Smirnov (n> 50) or Shapiro Wilk (n <50). The numerical variables were compared with the T test of two independent samples (Two Samples Independent Student's t-test) on normally distributed data or the Mann Whitney U Test if the data were not normally distributed[8].

For the categorical variable, the analysis test is done using chi square or fisher test. Data from the independent variables will be tested based on a discrimination test to get the area under the curve (AUC) of each independent variable, namely the index score of the ADVANCIS, CIN-risk, and NCDR scores.

Results and conclusion

This research was conducted at the Department of Cardiology and Vascular Medicine of H. Adam Malik General Hospital Medan from October 2018 to October 2019 with a total sample of 72 STEMI patients who underwent primary PCI at the Integrated Heart Center who met the inclusion and exclusion criteria. From 72 samples, 25 people (34.7%) were found in the AKI group and 47 people (65.3%) in the non-AKI group.

In the AKI group, there were 17 male subjects (68%) and 8 female subjects (32%). The mean age in the AKI group was 58 ± 10 years (table 1). The history of previous illnesses investigated in this study were diabetes mellitus, a history of previous acute renal impairment (AKI), chronic kidney failure, cardiovascular disease, and hypertension. In the AKI group, 11 people (44%) had a history of diabetes mellitus, 13 people (52%) had a previous AKI, 11 people (44%) had chronic kidney failure, and 18 people had a history of cardiovascular disease. 72%), and hypertension as many as 18 people (72%). The smoking history of AKI subjects was 15 people (60%), and the average body mass index of the AKI group was 25.5 ± 3.9 kg / m^2.

Table 1. Baseline Characteristics of Patients

Variables	AKI events		p-value
	AKI (n=25)	NON-AKI (n=47)	
Gender (n,%)	Male 17 (68) Female 8 (32)	Male 44 (93.6) Female 3 (6.4)	0.012[a]
Age (years)	58 ±10	57±8	0.751[b]
Diabetes mellitus (n,%)	11 (44)	14 (29.8)	0.344[a]
Prior AKI (n,%)	13 (52)	3 (6.4)	<0.001[a]
Chronic kidney disease (n,%)	11 (44)	0 (0)	<0.001[a]
Cardiogenic shock (n,%)	11 (44)	3 (6.4)	<0.001[a]
History of cardiovascular disease (n,%)	18 (72)	22 (46.8)	0.072[a]
History of cardiac arrest (n,%)	9 (36)	3 (6.4)	0.002[a]
Smoking (n,%)	15(60)	36(76.6)	0.229[a]
Systolic blood pressure (mmHg)	110 (60-180)	130 (70-220)	0.048[c]
Hematocryte (%)	34 (23-46)	42 (31-52)	<0.001[c]
Body mass index (kg/m^2)	25.5±3.9	25.8±3.8	0.804[b]
Onset (hours)	9.5 (3.5-11)	7 (1-11)	<0.001[c]
TIMI *risk*	4 (1-12)	3 (1-9)	0.004[c]
Contrast volume (cc)	120 (90-150)	120 (90-170)	0.210[c]
Killip Class(n,%)			
I	2 (8)	31 (66)	
II	1 (4)	11 (23.4)	<0.001[a]
III	11 (44)	2 (4.3)	
IV	11 (44)	3 (6.4)	
ADVANCIS score	8 (1-15)	2(0-7)	<0.001[c]
CIN-risk score	16 (4-21)	6(1-17)	<0.001[c]
NCDR score	52 (19-73)	27(15-67)	<0.001[c]

[a]Chi Square, [b]T independen, [c]Mann Whitney

At the time of admission, clinical parameters assessed were the incidence of cardiogenic shock, systolic blood pressure, onset at admission, TIMI value, and history of cardiac arrest at admission. In the AKI group, 11 people (44%) had cardiogenic shock. The median value of systolic blood pressure is 110 mmHg (60-180mmHg), median onset of 9.5 hours (3.5-11 hours), median TIMI risk is 4 (1-12), and a history of cardiac arrest was found in 9 people (36%). In the classification of risk of heart failure based on the classification of Killip, obtained subjects with Killip I as many as 2 people (8%), Killip II as much as 1 person (4%), Killip III and IV respectively as many as 11 people (44%). The amount of contrast use in the AKI group with a median of 120 cc (90-150cc).

For laboratory parameters, hematocryte and serum creatinine tests are performed at admission. The serum creatinine examination is then repeated 48-72 hours after the patient has performed a primary PCI to assess changes in serum creatinine levels and final creatinine clearance after the primary PCI. On hematocryte examination, the median hematocryte of AKI group was 34% (23% -46%). The kidney function examination values of the AKI group at admission and after the primary PCI are described in table 2. The median values of the ADVANCIS, CIN-risk, and NCDR scores in the sequential AKI group were 8 (1-15), 16 (4-21), and 52 (52 19-73).

In the non-AKI group, there were 44 male subjects (93.6%) and 3 women (6.4%). The mean age in this group was 57 ± 8 years. Previous history of disease, such as diabetes mellitus were 14 (29.8%), prior AKI were 3 (6.4%), history of cardiovascular disease ws found is 22 people (46.8%). The smoking history of non-AKI subjects were 36 (76.6%), and the mean body mass index of this group was 25.8 ± 3.8 kg / m2. In this group there was no chronic kidney failure.

The clinical parameters of the subjects of the non-AKI group at admission, obtained cardiogenic shock events were 3 people (6.4%). The median value of systolic blood pressure is 130 mmHg (70-220mmHg), with a median onset of 7 hours (1-11 hours), the median TIMI value is 3 (1-9). A history of cardiac arrest at admission was found in 3 people (6.4%). In the classification of risk of heart failure based on the classification of Killip, obtained subjects with Killip I were 31 people (66%), Killip II were 11 people (23.4%), Killip III were 2 people (4.3%), and Killip was 3 people (6.4%). The median value of the amount of contrast used when the primary PCI is 120 cc (90-170cc). In the hematocryte examination, the median hematocryte of the non-AKI group was 42% (31% -52%). The median values of the ADVANCIS, CIN-risk, and NCDR scores in the sequential non-AKI group were 2 (0-7), 6 (1-17), and 27 (15-67). The results of renal function examination at admission and after primary PCI of the non-AKI group are described in table 2.

Table 2. Characteristics of Subjects' Renal Function

Variables	AKI events		p-value
	AKI (n=25)	NON-AKI (n=47)	
Initial sCr (mg/dl)	1.3 (0.59-3.46)	0.82 (0.59-1.4)	<0.001
Late sCr (mg/dl)	1.7 (0.94-5.1)	0.96 (0.68-1.45)	<0.001
Initial CrCl (ml/min)	54.7 (24.7-117.9)	90.2 (58-120.4)	<0.001
Late CrCl (ml/min)	48.2 (8.6-122)	75 (49-125)	<0.001
Delta of sCr (mg/dl)	0.42 (0.32-2.99)	0.13 (-0.11 – 0.25)	<0.001
Estimated GFR (ml/min)	43 (12.1-106)	96.2 (58.2-123.9)	<0.001

The Mann-Whitney test was performed on kidney function parameters between the two groups and it was found that all of the above variables were statistically significant ($p < 0.05$).

Based on the analysis of ADVANCIS score data as a predictor of AKI events, the area under the curve (AUC) was 0.771 (77.1%) with a 95% CI (0.644-0.898) with a p value <0.001. These results indicate that the ability of the ADVANCIS score as a predictor of AKI after primary PCI is good with statistically significant results (Figure 1).

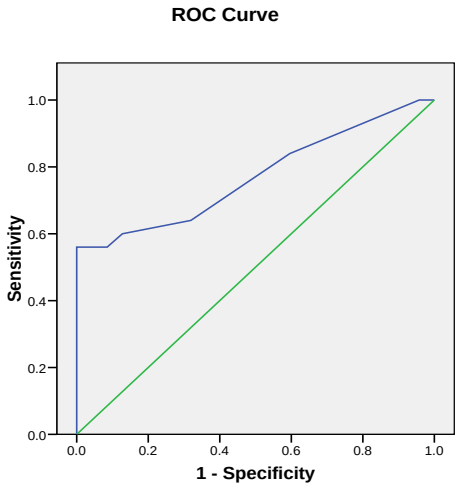

Figure 1. ROC curve of ADVANCIS score for the incidence of AKI

Based on the analysis of CIN-risk score data as a predictor of AKI events, the area under the curve (AUC) was 0.806 (80.6%) with a 95% confidence interval (0.695-0.916) with a p value <0.001. These results indicate that the ability of the CIN-risk score as a predictor of AKI is very good and is statistically significant (Figure 2).

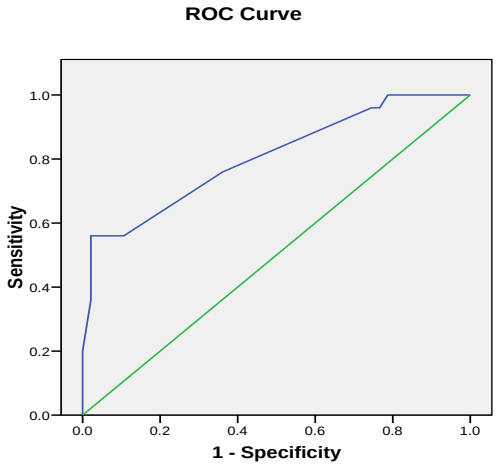

Figure 2. ROC curve CIN-risk score for the incidence of AKI

Based on the analysis of NCDR score data as a predictor of AKI events, the area under the curve (AUC) was 0.769 (76.9%) with a confidence interval of 95% (0.648-0.889) with a p value <0.001. These results indicate that the ability of the NCDR score as a predictor of AKI is good and is statistically significant (Figure 3).

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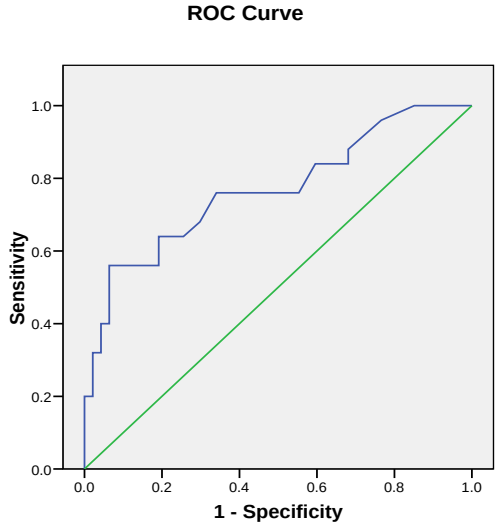

Figure 3. ROC curve of NCDR score for AKI events

The number of patients included in this study is 72 persons. From a total of 72 samples, 25 AKI (34.7%) were obtained, and 47 AKI (65.3%) did not experience AKI. Many previous studies have been conducted to assess the incidence of CIN (contrast-induced nephropathy) in AMI patients who undergo the PCI procedure. Current research has been widely developed to examine the deterioration of kidney function in patients with AMI, especially patients undergoing PCI or primary PCI. From a study conducted by Ningrum in 2008 at the Harapan Kita National Heart Center, CIN events were obtained up to 25% of the population undergoing coronary intervention[9], while a study conducted by Andra in 2010 on stable angina pectoris and Hasinah in 2016 in patients with acute coronary syndromes who underwent PCI found CIN incidence rates of 18% and 23.7% respectively at H. Adam Malik General Hospital Medan[10,11]. A study by Parlindungan in 2017 which was also conducted at H. Adam Malik Hospital in Medan found CIN rate of 18.82% of ACS patients undergoing PCI[12]. This variation in the incidence rate of CIN may be caused by differences in the definition used, as well as differences in the patient population based on the number and types of accompanying risk factors such as chronic kidney disease, and diabetes mellitus[13]. In this study alone, the term CIN is no longer used because along with the development of recent studies, it was found that contrast is not the only factor triggering the occurrence of kidney disorders after percutaneous coronary interventions of ACS patients. In this study the term acute kidney injury (AKI) was used using KDIGO criteria in 2012, namely an increase in serum creatinine levels ≥0.3mg / dl (≥26.5µmol / l) within 48 hours or an increase in serum creatinine levels ≥1.5 times from the baseline, which was previously known or assumed to have taken place within 7 days or decreased urinary volume <0.5ml / kg / hour for 6 hours.[2]

From table 1, it is found that the majority of AKI sufferers and those who do not experience AKI are male with 68% and 93.6% respectively. The mean age of patients in the two groups was not much different, namely 58 ± 10 years in the AKI group and 57 ± 8 years in the non-AKI group with p = 0.012. A study by Pei et al in 2018 in a study for the ADVANCIS score found that the average age of the AKI group was older than non-AKI which was 71 ± 11.7 years and 63.5 ± 13.2 years with a p value <0.00113. A 2014 study by Tsai in the NCDR cath-PCI registry found a mean age of 68.2 ± 12.4 years in the AKI group and 64.6 ± 12.2 years in the non-AKI group with a p value <0.00114. A study by Mehran et al in 2004 the mean age of all study subjects was 63.8 ± 11.2 years15. In H.Adam Malik General Hospital in 2017 by Parlindungan, the average age in the CIN and non-CIN groups was 53.12 ± 9.0 years and 55.04 ± 7.5 years respectively with p values = 0.47212. In this study and the other three studies of the AKI risk scoring system in PCI patients, it was found that age has a significant influence on the incidence of AKI.

Previous medical history was found to influence the incidence of AKI. In this study, it was found that previous AKI (52% vs 6.4%, p <0.001), chronic kidney failure (44% vs 0%, p <0.001), cardiogenic shock at admission

(44% vs 6.4%, p <0.001), history of cardiac arrest (36% vs 6.4%, p = 0.002), hypertension (72% vs 42.6%, p = 0.033), and systolic blood pressure with median respectively 110mmHg and 130mmHg (p = 0.048) in the group AKI and non-AKI are statistically significant. These results are in accordance with previous studies by Mehran (2004), Tsai et al (2014), and Pei et al (2018) who make these parameters as variables in calculating the scores of each researcher[13,14,15].

The use of contrast in the two groups in this study found no difference, that is, with a median of 120cc in both groups and was not statistically significant with p = 0.210. However, the score by Mehran et al in 2004, namely CIN risk, included contrast volume criteria as one of the score parameters with a p value <0.000115. The study by Parlindungan found contrast volume in the AKI group averaging 165.94 ± 41,802 cc and 146.04 ± 45,252 cc in the non-AKI group with a p value = 0.169, so the contrast volume in this study was not statistically significant[12]. Risk stratification according to TIMI risk and Killip was found to be statistically significant with the respective values p = 0.004 and p <0.001 respectively, where the TIMI risk and Killip in the AKI group were found to be higher in value than the non-AKI group. The onset of STEMI patients was also statistically significant where the median onset of the AKI group was 9.5 hours (3.5-11 hours) and non-AKI was 7 hours (1-11 hours) with p <0.001.

In tables 1 and 2, laboratory parameters at admission, hematocryte values, initial serum creatinine, initial clearance creatinine, and estimated glomerular filtration rate were found to be statistically significant for the incidence of AKI. The median hematocrit rate in the AKI group was lower than in the non-AKI group (34% vs 42%), creatinine clearance was lower in the AKI group (54.7ml / min vs. 90.2 ml / min), and the estimated glomerular filtration rate was also more was low in the AKI group (43ml / min vs 96.2 ml / min) with each p value <0.001. This parameter is then used as a variable to calculate CIN-risk and NCDR scores. In a study by Mehran, serum creatinine values> 1.5 mg / dl affected the incidence of CIN after ADI with a p value <0.0001[15]. The study by Tsai found that the estimated glomerular filtration rate value affects the incidence of AKI after PCI with an estimated LFG estimate in the AKI group of 64.2 ± 28.3ml / min and non-AKI of 73.6 ± 21.9ml / min with a p value <0.001[14]. A study by Parlindungan that observed the incidence of CIN after the IKP found that lower hematocrit levels were also found in the CIN group (35.75% vs 43.2%) with p <0.001[12]. Tsai stated that anemia affected the incidence of AKI, where 10.5% of the AKI group had anemia compared to only 3.2% of non-AKI subjects who had anemia with a p value <0.001[14].

The incidence of AKI in STEMI patients undergoing primary PCI in this study was 25 of 72 persons (34.7%). Several independent variables that were found to be significant in influencing the incidence of AKI in STEMI patients undergoing primary PCI include a history of AKI, chronic kidney disease, cardiogenic shock during admission, history of cardiac arrest, systolic blood pressure, hematocryte, onset, TIMI risk, Killip class, initial creatinine serum, initial creatinine clearance, and glomerular filtration rate were estimated in this study. The ADVANCIS, CIN risk, and NCDR scores can be used as a predictor score for the incidence of AKI in STEMI patients undergoing primary PCI with good statistical values. The CIN risk score has the best value as a predictor of AKI in STEMI patients undergoing primary IKP with good statistical value.

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References

[1] Eagle K.A, et al. Baseline Characteristics, Management Practices, and In-Hospital Outcomes of Patients Hospitalized with Acute Coronary Syndromes in the Global Registry of Acute Coronary Events (GRACE). Am J Cardiol. 2002 Aug 15;90(4):358-63
[2] KDIGO. Clinical Practice Guideline for Acute Kidney Injury. Kidney International Supplements. 2012. Volume 2. Supplements 1.
[3] Marenzi G, et al. Contrast Volume During Primary Percutaneous Coronary Intervention and Subsequent Contrast-Induced Nephropathy and Mortality. Ann Intern Med 2009;150:170e177.
[4] Marenzi G, et al. Acute Kidney Injury in ST-segment Elevation Acute Myocardial Infarction Complicated by Cardiogenic Shock at Admission. Crit Care Med 2010;38:438e444.

[5] Ronco, C. Happio, M., House. A., Bellommo R. Cardiorenal Syndrome. Journal of the American College of Cardiology.2008:52;1527-1539
[6] PERKI. Pedoman Tatalaksana Sindrom Koroner Akut. 2015. Centra Communications. Ed 3.
[7] European Society of Cardiology. ESC Guidelines for The Management of Acute Myocardial Infarction in Patients Presenting with ST-Segment Elevation. EHJ (2017)00, 1-66.
[8] Dahlan, Sopiyudin M. 2013. Besar Sampel dan Cara Pengambilan Sampel. Jakarta : Salemba Medika.
[9] Ningrum N.R., Yuniadi Y. 2008. Contrast Induced Nephropathy. J Kardiol Indonesia. 2009; 30:71-9.
[10] Andra CA, Hasan R, Siregar AA. Peningkatan Kadar Kreatinin Serum dalam 24 jam Pertama Paska Intervensi Koroner di RSUP.H.Adam Malik Medan. Repository USU. 2010.6-57.
[11] Hasinah, Hasan H, Mukhtar Z. Hubungan skor grace dengan kejadian contrast induced nephropathy (CIN) pada penderita sindroma koroner akut yang menjalani tindakan intervensi koroner perkutan di RSUP H Adam Malik Medan. Repository USU. 2015.
[12] Parlindungan, Herman W., Akbar Nizam Z., Nasution Ali N., dkk. 2017. Hubungan Antara Skor CHA2DS2-VASC Dengan Kejadian Nefropati Yang Diinduksi Kontras Pada Pasien Infark Miokard Akut Yang Menjalani Prosedur Intervensi Koroner Perkutan. Repository USU.
[13] Pei-Chun Fan, Tien-Hsing Chen, Cheng-Chia Lee, et al. ADVANCIS Score Predicts Acute Kidney Injury After Percutaneous Coronary Intervention for Acute Coronary Syndrome. International Journal of Medical Sciences 2018;15(5):528-535.
[14] Tsai T, Patel U, Chang T, et al. Validated Contemporary Risk Model of Acute Kidney Injury in Patients Undergoing Percutaneous Coronary Interventions: Inights From the National Cardiovascular Data Registry Cath-PCI Registry. JAHA:2014;3:E001380.
[15] Mehran R, Aymong E.D, Nikolsky E, et al. A simple Risk Score for Prediction of Contrast-Induced Nephropathy After Percutaneuous Coronary Intervention. JACC 2004;44:1393-1399.