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The Incidence of Contrast Induced Nephropathy-Acute Kidney Injury after cardiac catheterization in Basra Cardiac Catheterization Center. A Prospective Cohort Study

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Abstract

Introduction: Patients who opt for coronary interventions to help them with their IHD problems face several adverse reactions; the most frequently faced is acute kidney injury from contrast media exposure or contrast induced nephropathy. Those patients have higher mortality and morbidity both in the short and longterm period. The incidence of this adverse reaction in Al-Basra Cardia Center is poorly studied so far. We measured the incidence of AKI in this center and tried to correlate the risk with some important covariates identified by previous researches. **Method:** this was an observational prospective study. It was a part of the double blind single center study (the effect of spironolactone on the incidence of AKI in patients with Stable IHD admitted for coronary intervention, trial registration: ClinicalTrials.gov NCT03329443). **Results:** The overall incidence of CIN was 20.2% in this cohort sample. Priori defined high risk variables were tested in univariate logistic regression, and if found to be significant they were to be added to a Multi-Logistic regression model analysis. In Regression analysis only GFR (Log Odds ratio) [0.984 (0.971-0.998)] and Mehran Risk score [Mehran >6 (2.456(1.335-4.519), Mehran >11 (3.931) Mehran >16 (12.366) compared to Mehran <5) were positive in the model analysis. **Conclusion:** there seems to be a high incidence of AKI in this cohort. Important significant factors include low GFR and a good correlation with Mehran risk score.

Key words: *AKI, Acute Kidney Injury, CIN, Contrast Induced Nephropathy, Angiography, PCI, Percutaneous Coronary Intervention, IHD, Ischemic Heart Disease, CI-AKI, Mehran risk score*

Introduction

Contrast induced nephropathy-Acute Kidney Injury (CIN-AKI) is a well-established complication of coronary angiography or any procedure involving the administration of Intravenous Contrast Agents regardless of the type [1–5]

Affected patients have higher cardiac and non-cardiac adverse events post procedure including and not limited to mortality even in patients without practical clinical manifestations or a need for dialysis or follow up [6–11]

Our Basra Cardiac center is relatively new opened since 2012 and the incidence of CIN-AKI in our center is not rigorously identified as far as we know.

Method

This study was a prospective cohort study at Al-Basra Cardiac Catheterization (Iraq-Basra) between September 2017 and June 2018. The study protocol was reviewed and approved by the institutional review board in the hospital and Baghdad University. All patients gave an informed consent to be included in the study.

Four hundred ninety patients were prospectively followed up that composed the total study group of our study population (the effect of spironolactone on the incidence of AKI in patients admitted for coronary angiography). Patients' inclusion and exclusion criteria along with detailed trial design and rationale is reported previously [12].

Briefly, Patients' demographic data were prospectively collected at admission date by researchers

using a prespecified datasheet and is called upon on day 2-3 for further interview and data collection. Coronary angiography/plasty were done by a senior cardiologist according to an established local and global (American College of Cardiology/American Heart Association) standard practice via the femoral approach [13].

The use of CIN prophylaxis was left to the treating physician but whoever received a pre-angio protocol and/or an isotonic fluid after were carefully collected by the research team.

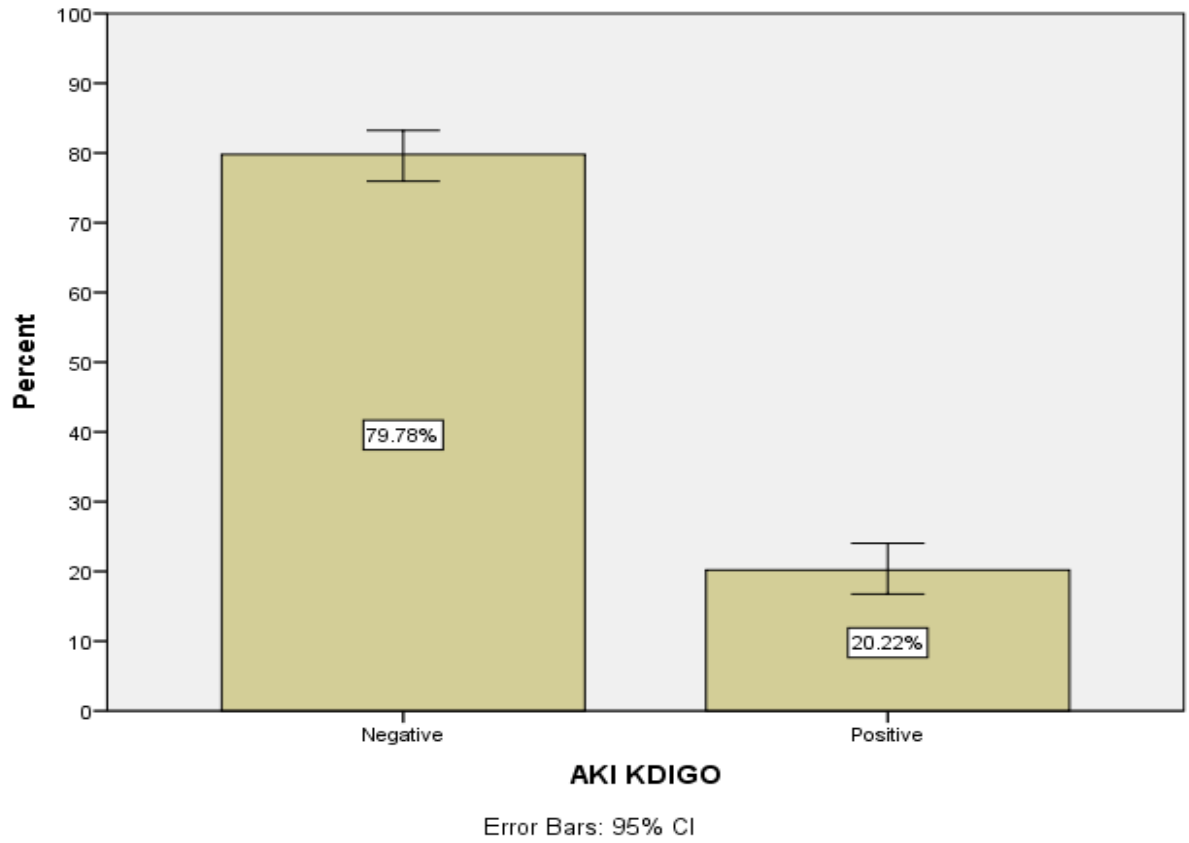
A suitable amount of blood was taken from each patient immediately prior to the procedure and 2-3 days later. Measured parameters included serum creatinine at admission and after 2-3 days, serum Potassium at admission and after 6hours later. CIN was defined according to K-DIGO guidelines as an increase of 0.3mg/dL or more than 0.25% elevation of Serum creatinine from baseline within 2-3 days of the procedure.

Statistical analysis

All statistical analysis was done using IBM SPSS Statistics 23. Continuous variables were recorded as Mean ± Standard Deviation (SD); categorical variables were recorded as a percentage (%). Normally distributed data were compared using suitable parametric tests. For any deviation from normality, a variable will be subject to a suitable transformation or switch to non-parametric tests. Logistic regression and model analysis was done for analysis of the effect of specifically predefined covariates on the incidence of CIN in the selected group. A p-value of 0.05 was set to be significant.

Result

The overall incidence of CIN was 20.2% in this cohort sample as shown in figure 1. Patients with AKI had a higher Serum Creatinine after 2-3 days Figure 2. They also tend to have a lower GFR [96.54(19.57) vs. 77.24 (21.31)], received more massive amount of Dye [248 (142.32)vs 208 (133.99)], especially more than 150 ml per procedure [71.28% vs. 63.07%], more probably having DM, congestive heart failure, a higher Mehran risk score and an initial Serum Creatinine at presentation, table 1



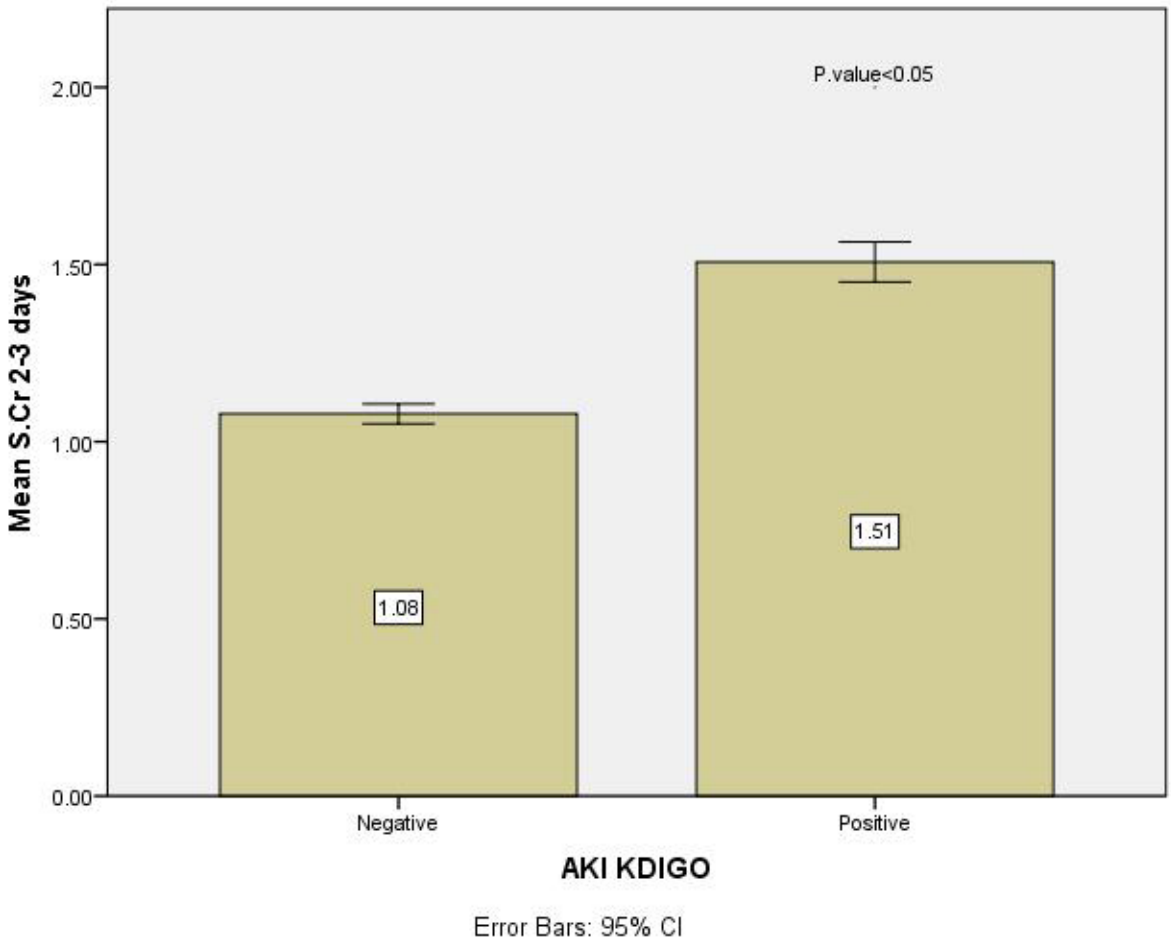


Table 1. Baseline characteristics of patients with and without CIN

Negative Mean (SD) or count (%)		AKI KDIGO		Significance
		Positive		
		Mean (SD) or count (%)		
Age		58 (7.96)	58 (7.6)	N.S.
Gender	(Male)	233 (62.8 %)	57 (60.64 %)	N.S.
Weight		75.4 (13.86)	78.1 (14.75)	N.S.
GFR		77.24 (21.31)	69.54 (19.57)	S
Dye Volume		208 (133.99)	248 (142.32)	S
Dye Vol> 150mL		219 (59.03 %)	67 (71.28 %)	S
PCI		234 (63.07 %)	67 (71.28 %)	N.S.
Antiplatlets		340 (91.64 %)	86 (91.49 %)	N.S.
ACE Inhibitors		331 (89.22 %)	83 (88.3 %)	N.S.
Stent Type	DES	252 (67.92 %)	67 (71.28 %)	N.S.
Artery	none	120 (32.35 %)	27 (28.72 %)	N.S.
	RCA	80 (21.56 %)	23 (24.47 %)	N.S.
	LAD	19 (5.12 %)	8 (8.51 %)	N.S.
	LCX	71 (19.14 %)	17 (18.09 %)	N.S.
	Multiple	81 (21.83 %)	19 (20.21 %)	N.S.

Table 1. Baseline characteristics of patients with and without CIN

Hypertension		332 (89.49 %)	84 (89.36 %)	N.S.
DM		122 (32.88 %)	48 (51.06 %)	S
Lasix		25 (6.74 %)	7 (7.45 %)	N.S.
Metformin		102 (27.49 %)	42 (44.68 %)	S
Mehran Quartile	1	191 (88%)	25 (12 %)	S
	2	146 (75 %)	48 (25 %)	S
	3	32 (65 %)	17 (35 %)	S
	4	2 (33 %)	4 (67 %)	S
Hydration		27 (7.28 %)	4 (12.9 %)	N.S.
S.Cr1		1.08 (0.23)	1.14 (0.24)	S
S.NGAL at 0hrs		14.7 (3.81)	15.2 (4.33)	N.S.

Interesting to note that the incidence of AKI did not depend on the type of procedure (PCI vs. Angiography), and type of artery involved in the intervention.

Drugs during the periangio period include ACE inhibitors and hydration that were not associated with either an increase or a decrease in AKI incidence, while there was a negative influence in patients taking Metformin on the incidence of AKI in this cohort.

All previously mentioned risk factors in our analysis were added to a Logistic regression model analysis as shown in figure 2. In Multivariate Logistic Regression analysis only GFR (Log Odds ratio) [0.984 (0.971-0.998)] and Mehran Risk score [Mehran >6 (2.456(1.335-4.519), Mehran >11 (3.931) Mehran >16 (12.366) compared to Mehran <5) remained positive in the model analysis.

Table 2. Univariate and multivariate Logistic regression analyses of predictors of CIN.

Univariate Logistic Regression				**Multivariate Logistic Regression**				
Variable	**Odds ratio**	**df**	**Sig.**	**Variable**	**Log Odds ratio**	**95% C.I.of Log Odds ratio**		**Sig.**
						Lower	**Upper**	
GFR	**7.787**	**1**	**0.01**	**GFR**	**0.984**	**0.971**	**0.998**	**0.02**
MehranQuartile	23.072	3	0	MehranQuartile				0
MehranQuartile(2)	2.05	1	0.15	MehranQuartile(2)	2.456	1.335	4.519	0
MehranQuartile(3)	6.961	1	0.01	MehranQuartile(3)	3.931	1.723	8.968	0
MehranQuartile(4)	7.98	1	0.01	MehranQuartile(4)	12.366	2.105	72.645	0.01
SCr1	5.899	1	0.02					
Dye Volume	7.757	1	0.01					
Dye> 150	5.599	1	0.02					
DM	8.955	1	0					
CHF	13.214	1	0					
Metformin	7.785	1	0.01					

Discussion

The main finding in our study is that there is an alarmingly high rate of CIN in this trial cohort. Several reports have calculated the risk of CIN in various populations including the higher risk sample (patients admitted for coronary intervention). The risk is usually low and correlate well with Mehran risk score (≈ 3% in low risk groups and up to 60% and more in high risk groups) [4,14,15]

The overall risk in our trial was around 20%, and this is higher than most of the reported incidence in the global centers (2-14%) [14,15]. On further analysis patients from Iraqi population might have a similarly high incidence as a similar study in Babil Center has demonstrated a higher risk (40% in a small cohort sample, Mehran score was not reported for an appropriate comparison). Another study was done in Erbil center and reported an incidence of 13% which is also high but come within the high range of some reported incidences in global centers[16,17]. Similar high rates (23%-31%) were also have been reported in nearby Iraqi centers [18–20].

Many possibilities could be the basis of this reported outlier. First, this trial cohort has a relatively higher Mehran risk score than the populations usually tested in similar studies reported in the literature. A study by Taher et al. in Egypt has reported an overall incidence of 13%, but the majority of its cohort (84.5%) were in the low risk category. Compared to our cohort which has only 44% in the same risk category. Interesting to note that the incidence of AKI in our low risk group was 12% which is an excellent approximation to the Taher et al. trial.[4]

Such high percentages might be due to the lack of using preventive measures at the time of PCI [21–25]. The use of hydration before and after the procedure is a well-known prophylactic procedure given liberally to almost all patients at the periPCI time [22–28]. Our sample of patients came fasting for at least 8 hours before the procedure. Such fasting may aggravate dehydration and compromise the already defective renal parenchyma during a period of toxicity or ischemia and augment the toxic effects of contrast agents on the nephrons [7,8,28,29]. Some of our patients received post procedure I.V. fluid, and they are also given oral fluid after the procedure. Those who received I.V. fluid (mostly because of PCI related issues) had a decreased incidence of AKI but unfortunately not significant because of the low sample size (no. of patients who received post contrast hydration was only 31 patients with an estimated CIN of 13%) incorporated in our analysis.

Mehran risk score was widely accepted as a standard risk score to calculate and manage the risk of AKI in order to apply a suitable preventive measure in selected high risk patients [15,30]. This trial tried a similar analysis given the considerable reduction in power (this sample were around 500 patients, and Mehran et al. used more than 5000 patients to develop the model). We analyzed each factor in Mehran score individually and then the complete final score at last[1].

Individual risk factors that were associated with AKI include (DM, HF, S.Cr>1.4 and contrast media over 150 ml/procedure) this cohort did not receive Intraaortic balloon pump counterpulsation (IAPB), nor they had significant hypotension at the procedure. These risk factors were previously described by Mehran et al. as an independent risk factors for the development of CIN [15].

All individually significant risk factors along with Mehran risk score were added to a multivariate logistic regression analysis to define the independent power of each factor alone given the interaction with other factors. In this analysis, only Mehran risk score and GFR remained significant after correction for other covariates in the analysis. This results contrast with a similar study by Shams-Eddin et al who reported that contrast type, volume of contrast above 400 and Age above 65years were the only predictors of CIN. Shams-Eddin et al. did not show any significant effect of Mehran score with CIN, but again the majority of the studies population were in the low range (Mehran <6) score. This study population had a higher sample size (490 compare 200 for Shams-Eddin et al.) and a significant proportion of this cohort were in the mid-High risk range as well [4]

Conclusion

There seems to be a high incidence of CIN-AKI in this trial cohort and the risk correlate well with Mehran risk score.

Ethical Clearance: The Research Ethical Committee at scientific research by ethical approval of both environmental and health and higher education and scientific research ministries in Iraq

Conflict of Interest: The authors declare that they have no conflict of interest.

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References

1. Lansky AJ, Dangas G, Nikolsky E, Stone GW, Iakovou I, Aymong ED, et al. A simple risk score for prediction of contrast-induced nephropathy after percutaneous coronary intervention. J Am Coll Cardiol 2004;44(7):1393–9.
2. Aurelio A, Durante A. Contrast-Induced Nephropathy in Percutaneous Coronary Interventions : Pathogenesis , Risk Factors , Outcome , Prevention and Treatment. 2014;62–72.
3. Azrini AA, Goh BL, Ibrahim FH, Lim CTS, Aida AA, Abdul Muizz AM. 140 Incidence and Risk Factors for Contrast Induced Nephropathy in Patients Undergoing Percutaneous Coronary Intervention At a Tertiary Centre. Kidney Int Reports 2017;2(4):S36.
4. Shams-Eddin Taher H, Hassan AKM, Dimitry SR, Mahfouz AK. Predicting contrast induced nephropathy post coronary intervention: A prospective cohort study. Egypt Hear J 2015;67(4):337–43.
5. Silver SA, Shah PM, Chertow GM, Harel S, Wald R, Harel Z. Risk prediction models for contrast induced nephropathy: Systematic review. BMJ. 2015;351.
6. Perrin T, Descombes E, Cook S. Contrast-induced nephropathy in invasive cardiology: Incidence, pathophysiology, diagnosis, prevention and prognosis. Swiss Med Wkly. 2012;142(JUNE):1–11.
7. Shah R, Wood SJ, Khan SA, Chaudhry A, Rehan Khan M, Morsy MS. High-volume forced diuresis with matched hydration using the RenalGuard System to prevent contrast-induced nephropathy: A meta-analysis of randomized trials. Clin Cardiol 2017 Dec;40(12):1242–6.
8. Perrin T, Descombes E, Cook S. Contrast-induced nephropathy in invasive cardiology. Swiss Med Wkly 2012 Jun 19;142(2526).
9. Xu H, Chen L, Li X. [Risk factors and prognosis of contrast-induced nephropathy with renal dysfunction]. Zhongguo Yi Xue Ke Xue Yuan Xue Bao 2005;27(2):232–6.
10. Zaytseva N V., Shamkhalova MS, Shestakova M V., Matskeplishvili ST, Tugeeva EF, Buziashvili UI, et al. Contrast-induced nephropathy in patients with type 2 diabetes during coronary angiography: Risk-factors and prognostic value. Diabetes Res Clin Pract 2009 Dec 1;86:S63–9.
11. McCullough PA, Adam A, Becker CR, Davidson C, Lameire N, Stacul F, et al. Epidemiology and Prognostic Implications of Contrast-Induced Nephropathy. Am J Cardiol 2006 Sep 18;98(6):5–13.
12. Mujtaba A, Taher MA, Hazza MA, Al-Rubaye HM, Kata AH, AbdulWahab H, et al. The Effect of Spironolactone on the Incidence of Contrast-Induced Nephropathy in Patients Undergoing Cardiac Catheterization: Study Design and Rationale. Cardiol Ther. 2018;7(1):101–6.
13. Calhoon JH, Maron DJ, Smith PK, Dehmer GJ, Patel MR, Grantham JA, et al. ACC/AATS/AHA/ASE/ASNC/SCAI/SCCT/STS 2017 Appropriate Use Criteria for Coronary Revascularization in Patients With Stable Ischemic Heart Disease. J Am Coll Cardiol. 2017;69(17):2212–41.
14. Rihal CS, Textor SC, Grill DE, Berger PB, Ting HH, Best PJ, et al. Incidence and Prognostic Importance of Acute Renal Failure After Percutaneous Coronary Intervention. Circulation 2002 May 14;105(19):2259–64.
15. Mehran R, Nikolsky E. Contrast-induced nephropathy: Definition, epidemiology, and patients at risk. Kidney Int 2006 Apr 1;69:S11–5.
16. Contrast Induced Nephropathy In Diabetic And Non-Diabetic Patients Underwent Percutaneous Coronary Intervention In Erbil City. 2017;16(1):9–14.
17. Nassir SF. Contrast Induced Nephropathy in Diabetic and Non Diabetic Patients After Coronary. 2014;(9):2530–46.
18. Al-tu FJ, Dheyauldeen H, Al-saegh RM. Measurement of urinary kidney injury molecule-1 as a predictive biomarker of contrast-induced acute kidney injury. J Contemp Med Sci. 2017;3(9):178–81.
19. Al-saffar HB, Yassin AJ, Ali A. Delayed Recovery of Contrast Induced Kidney Injury Post Angiography : Rate and Risk Factors. 2015;57(3):183–7.
20. Rasheed JI, Khudder M, Razak A, Mahdi AG. Contrast- Induced Nephropathy after Coronary Angiography. Int J Sci Res 2017;6(7):767–73.
21. Liu Y, Chen JY, Huo Y, Ge JB, Xian Y, Duan CY, et al. Aggressive hydraTion in patients with

ST-Elevation Myocardial infarction undergoing Primary percutaneous coronary intervention to prevenT contrast-induced nephropathy (ATTEMPT): Study design and protocol for the randomized, controlled trial, the ATTEMPT, . Am Heart J 2016;172:88–95.

22. Oliveira DB. Prophylaxis against contrast-induced nephropathy. Lancet 1999 May;353(9165):1638–9.
23. Barrett BJ, Parfrey PS. Prevention of Nephrotoxicity Induced by Radiocontrast Agents. N Engl J Med 1994 Nov 24;331(21):1449–50.
24. Solomon R, Werner C, Mann D, D'Elia J, Silva P. Effects of Saline, Mannitol, and Furosemide on Acute Decreases in Renal Function Induced by Radiocontrast Agents. N Engl J Med 1994 Nov 24;331(21):1416–20.
25. Mueller C, Buerkle G, Buettner HJ, Petersen J, Perruchoud AP, Eriksson U, et al. Prevention of Contrast Media–Associated Nephropathy. Arch Intern Med 2002 Feb 11;162(3):329.
26. Paul Taggart D, Sousa Uva M, Torracca L, G. Stefanini G, Windecker S, Alfonso F, et al. 2014 Esc/Eacts Guidelines on Myocardial Revascularization. Russ J Cardiol. 2017;(2):5–81.
27. Fliser D, Laville M, Covic A, Fouque D, Vanholder R, Juillard L, et al. A European Renal Best Practice (ERBP) position statement on the Kidney Disease Improving Global Outcomes (KDIGO) Clinical Practice Guidelines on Acute Kidney Injury: Part 1: definitions, conservative management and contrast-induced nephropathy. Nephrol Dial Transplant 2012 Dec 1;27(12):4263–72.
28. Schweiger MJ, Chambers CE, Davidson CJ, Zhang S, Blankenship J, Bhalla NP, et al. Prevention of contrast induced nephropathy: Recommendations for the high risk patient undergoing cardiovascular procedures. Catheter Cardiovasc Interv 2007 Jan 1;69(1):135–40.
29. Bonventre J, Yang L. Cellular pathophysiology of ischemic acute kidney injury. J Clin Invest. 2011;121(11):4210–21.
30. Mehran R, Pocock SJ, Nikolsky E, Clayton T, Ms C, Dangas GD, et al. A Risk Score to Predict Bleeding in Patients With Acute Coronary Syndromes. JAC 2010;55(23):2556–66.