International Journal of Cardiology 172 (2014) e293–e296

Contents lists available at ScienceDirect

International Journal of Cardiology

journal homepage: www.elsevier.com/locate/ijcard

Letter to the Editor

Novel preprocedural and acute-phase postprocedural predictive factors for contrast-induced kidney injury in CKD patients

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ARTICLE INFO

Article history:
Received 9 November 2013
Accepted 28 December 2013
Available online 8 January 2014

Keywords:
Chronic kidney disease (CKD)
Contrast-induced acute kidney injury (CIAKI)
Urinary liver fatty acid binding protein (L-FABP)
Urinary neutrophil gelatinase-associated lipocalin (NGAL)
Urinary albumin creatinine ratio (UACR)

Contrast-induced acute kidney injury (CIAKI) is one of the major critical complications of coronary angiography (CAG) and/or percutaneous coronary intervention (PCI) [1,2]. In particular, among patients with preexisting chronic kidney disease (CKD) who have undergone CAG/PCI, the incidence of CIAKI is relatively higher [3]. One of the biggest limitations of CIAKI is that the serum creatinine level typically peaks around 2–3 days after the administration of contrast media; therefore, the initial measurement of serum creatinine does not represent acute kidney injury. Thus, it is important to establish reliable markers for kidney injury in the preprocedural and/or immediate postprocedural phase of minimum contrast media.

The aim of this study was to determine useful predictors of contrast-induced kidney injury in the preprocedural and early postprocedural phases in CKD patients undergoing angiographic procedures.

We enrolled a total of 105 consecutive CKD patients between the ages of 20 and 85 years who underwent scheduled CAG/PCI between 2010 and 2011 at a single center (Nagoya University Hospital). CKD was defined as a baseline estimated glomerular filtration rate (eGFR) of less than 60 mL/min/1.73 m^2, which was calculated according to the Modification of Diet in Renal Disease formula [4]. The patients were divided into two groups (eGFR without further deterioration group: eGFR $\geq$ 0 mL/min/1.73 m^2 vs. eGFR with further deterioration group: eGFR $<$ 0 mL/min/1.73 m^2 at 48 h after the procedure compared with the baseline). All patients received intravenous hydration with 1.0 mL/kg/h of saline before and after contrast administration. The saline was infused at 1.0 mL/kg/h for 12–18 h before and for 6 h after the procedure. The serum samples and general urine samples were measured at 12–24 h before the procedure and at 48 h after the procedure. The urinary NGAL (neutrophil gelatinase-associated lipocalin) and L-FABP (liver fatty acid binding protein) levels were measured at 12–24 h before the procedure and at two and 48 h after the procedure. The urinary NGAL and L-FABP levels were measured using available enzyme-linked immunosorbent assay kits (NGAL; R&D Systems, Inc. USA) (L-FABP; CMIC Co. Ltd., Tokyo, Japan).

The STATA/SE11 software program was used for all statistical analyses. Continuous variables were presented as the mean $\pm$ standard deviation or median (interquartile range). Differences between the two groups were evaluated using Student's unpaired *t*-test or the Wilcoxon test if the distribution was abnormal. Categorical variables were presented as numbers (percentages), and comparisons between the two groups were made using the chi-square test. The cutoff value was determined using a receiver operating characteristic (ROC) analysis to predict a deteriorated eGFR at 48 h after the use of contrast media. A logistic regression analysis was used to determine which factors were correlated with a deteriorated eGFR. All reported P values are two-sided, and $P < 0.05$ was considered to be statistically significant.

Written informed consent was obtained from all patients. The study protocol was approved by the hospital's ethics committee. The authors of this manuscript comply with the Principles of Ethical Publishing in the International Journal of Cardiology.

Table 1 shows the baseline clinical characteristics of the enrolled patients. The significant difference was only observed in the baseline urinary albumin creatinine ratio (UACR). The baseline renal function markers were comparable in the two groups, including the levels of serum creatinine, eGFR and serum cystatin C. Fig. 1 shows the time course changes in the levels of serum creatinine, serum cystatin C, urinary NGAL and urinary L-FABP. When compared with that observed

Abbreviations: CAD, coronary artery disease; CIAKI, contrast-induced acute kidney injury; CKD, chronic kidney disease; eGFR, estimated glomerular filtration rate; LVEF, left ventricular ejection fraction; L-FABP, liver fatty acid binding protein; NGAL, neutrophil gelatinase-associated lipocalin; UACR, urinary albumin creatinine ratio.

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0167-5273/$ – see front matter
http://dx.doi.org/10.1016/j.ijcard.2013.12.193

Table 1
Baseline characteristics of the study patients.

	All (n = 105)	Without deterioration eGFR (n = 47)	With deterioration eGFR (n = 58)	P value
Age (years)	75 (70 to 79)	72 (70 to 78)	76(70 to 80)	0.152
Male (%)	70.5%	74.5%	69.0%	0.535
Body mass index (kg/m^2)	23.4(3.3)	22.9(3.3)	23.8(3.2)	0.172
Systolic blood pressure (mm Hg)	131.4(18.6)	129.7(20.3)	132.7(17.2)	0.409
Diastolic blood pressure (mm Hg)	69.0(16.0)	68.7(11.2)	69.1(19.1)	0.905
Hct (mg/dl)	37.0(5.0)	37.1(5.1)	36.8(5.0)	0.768
BUN (mg/dl)	21(17 to 26)	21(18 to 26)	21(17 to 27)	0.982
Cre (mg/dl)	1.22(0.40)	1.24(0.40)	1.21(0.39)	0.361
Cystatin C (mg/dl)	1.44 (1.24 to 1.69)	1.36 (1.20 to 1.64)	1.46 (1.27 to 1.72)	0.176
eGFR	45.0(9.9)	46.0(8.7)	44.1(10.9)	0.318
UACR (mg/g Cr)	29.2 (9.1 to 126.8)	12.3 (6.8 to 33.4)	50.9 (15.4 to 269.2)	0.002
Hypertension (%)	81.0%	78.7%	83.8%	0.601
Diabetes mellitus (%)	47.6%	55.3%	50.0%	0.137
Dyslipidemia (%)	62.9%	59.6%	65.5%	0.531
Myocardial infarction (%)	15.2%	19.2%	12.1%	0.315
Congestive heart failure (%)	9.5%	8.5%	10.3%	0.750
Medication				
ACE inhibitors (%)	15.2%	14.9%	15.5%	0.930
Angiotensin II receptor blockers (%)	61.9%	57.5%	65.5%	0.397
Calcium-channel blockers (%)	47.6%	42.3%	51.7%	0.349
Statins (%)	67.6%	66.0%	69.0%	0.743
Contrast media volume (mL)	65.7 (31.6)	69.7 (35.8)	62.7 (27.9)	0.269
LVEF (%)	60.6 (14.4)	57.9 (15.9)	62.7 (13.0)	0.101
Current smoker (%)	30.5%	38.3%	24.1%	0.117
Current alcohol drinkers (%)	20.0%	23.4%	17.2%	0.432

The data are presented as the mean (SD) or median (interquartile range) for continuous variables and percentages for categorical variables.
ACE, angiotensin-converting enzyme.
UACR, urinary albumin creatinine ratio.
LVEF, left ventricular ejection fraction.

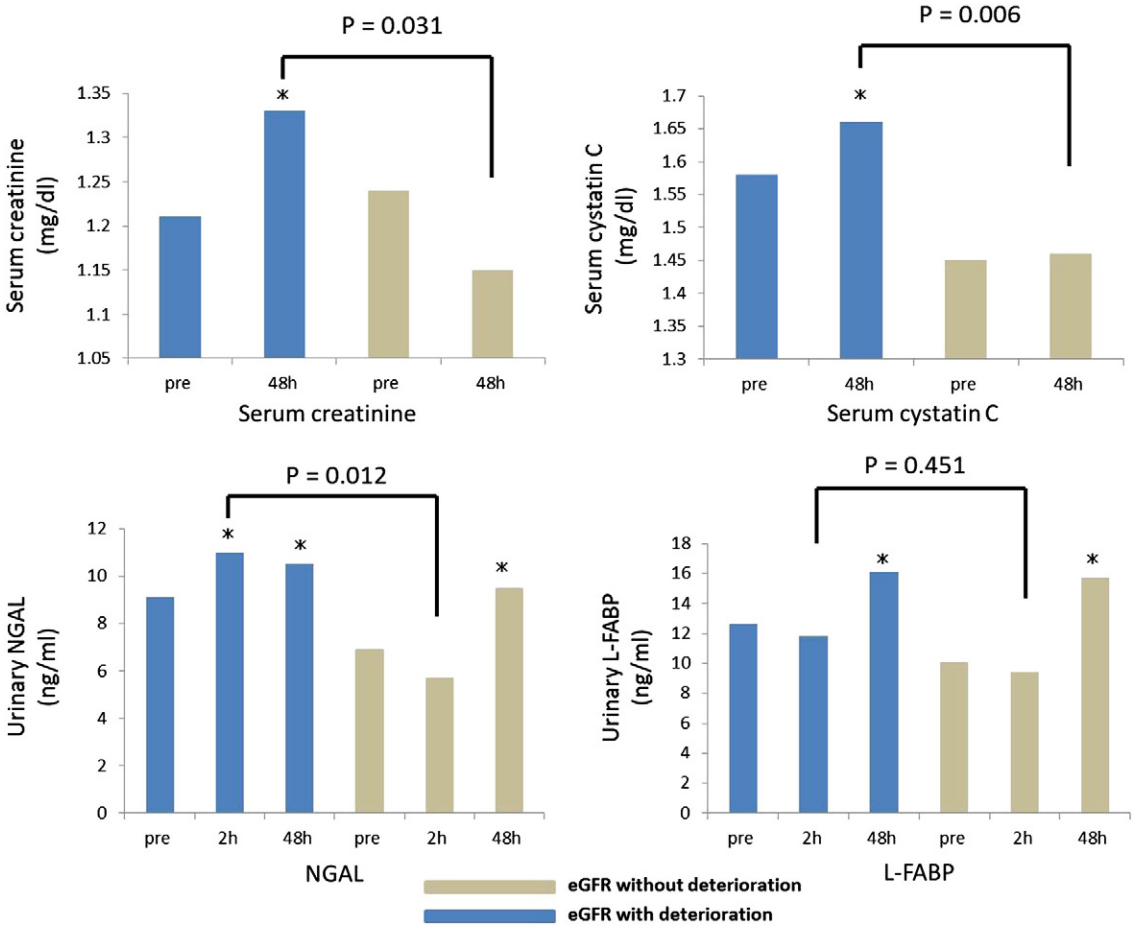

Fig. 1. A comparison of the time course changes in the renal functional markers in the two groups. The time course changes in the median levels of serum creatinine, serum cystatin C, urinary NGAL and urinary FABP are shown. *, $P < 0.05$; compared with the baseline value.