Assessment of Brain Natriuretic Peptide in Contrast-induced Nephropathy in Patients with Acute Coronary Syndrome Undergoing Coronary Artery Intervention

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ABSTRACT

Background: Acute coronary syndrome (ACS), which encompasses unstable angina (UA), non-ST elevation myocardial infarction (NSTEMI), and ST elevation myocardial infarction (STEMI), is frequently caused by atherosclerotic plaque rupture or superficial plaque erosion. One of the leading causes of death worldwide is ACS. Notwithstanding considerable progress in therapy over the previous couple decades.

Objective: The current study aimed to evaluate the brain natriuretic peptide's diagnostic value for identifying contrast-induced nephropathy (CIN) after intervention with the coronary artery.

Patients and methods: A total of 150 patients participated in this cohort study, which was conducted at the Cardiology Department of Zagazig University and El-Ahrar Teaching Hospital in the Sharkia Governorate. Participants were divided into 2 groups: Group I included CIN sufferers and Group II included those who lack a CIN.

Results: A total of 104 patients were followed up and fulfilled our inclusion criteria; **the** CIN group included 16 (15.4%) patients and he No-CIN group had 88 (84.6%) patients. Male gender was (62.5%) in our research. Patients who had CIN were noticeably older than those who did not. The analysis at hand found that baseline and NT-pro BNP levels varied statistically significantly in comparison to the study groups (both were considerably greater in the CIN group).

Conclusion: NT-proBNP or BNP may be reliable predictors of CIN

Keywords: Brain natriuretic peptide, Contrast-induced nephropathy, Coronary artery intervention, Acute coronary syndrome, Cohort study, Zagazig University.

INTRODUCTION

Acute coronary syndrome (ACS), which encompasses unstable angina (UA), non-ST elevation myocardial infarction (NSTEMI), and ST-elevation myocardial infarction (STEMI), is frequently caused by atherosclerotic plaque rupture or superficial plaque erosion. Although ACS treatment has made great progress in recent decades, ACS remains a leading cause of death globally [(1)]. Coronary angiography is crucial for ACS patients. For UA and NSTEMI, when complicating comorbidities are absent, urgent the first course of treatment for STEMI is advised to be percutaneous coronary intervention (PCI). Still recommended is early invasive treatment involving heart catheterization and revascularization. These treatments can increase prognosis and lower death in ACS patients [(2)].

A frequent and serious consequence that affects inpatients is acute kidney injury (AKI) and is responsible for a considerable amount of mortality as well as other major consequences. Due to exposure to contrast agents, patients with ACS, AKI is more likely to develop in those who are having PCI or coronary angiography, in particular [(3)].

Poor clinical outcomes, such as death, unfavorable cardiac events, and stent restenosis, are substantially linked with the emergence of CI-AKI stands for coronary angiography-induced acute kidney damage. Early detection of those at risk for CI-AKI is crucial so that the treating physician can take preventative measures the appropriate preventative measures [(4)].

In reaction to pressure overload, ventricular dilatation, or myocardial ischemia, the blood is filled with brain natriuretic peptides that are released. There have been reports of B-type natriuretic peptide (BNP) or N-terminal pro-B-type natriuretic peptide (NT-proBNP) concentrations to be increased in individuals with ACS and have predictive significance. Additionally, several studies have discovered that Patients with AKI had increased BNP or NT-proBNP levels, especially those who have ACS and get PCI or coronary angiography [(5).]

The current study aimed to evaluate the brain natriuretic peptide's diagnostic value for identifying contrast-induced nephropathy (CIN) after intervention with the coronary artery.

PATIENTS AND METHODS

Type of study: Cohort study.

Study setting: El-Ahrar Teaching Hospital and the Cardiology Department of Zagazig University are both in the Sharkia Governorate.

Inclusion criteria: More than 18 middle aged patients getting coronary intervention for ACS Patients having a history of drug use that has an impact were included. BNP level such as B-blockers, ACES, ARBs and spironolactone are advised to stop these drugs at least 48 hours before the procedure.

Exclusion criteria: Patients who are unsuitable for coronary intervention, hypertensive emergencies and

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decompensated congestive heart failure, refractory arrhythmia, renal impairment, decompensated liver illness, hemorrhagic blood disease, thyroid problems, active infection, marked obesity, pregnancy, contrast medium allergy, and advanced cancer are some conditions that warrant immediate medical attention.

Sample Size: Sample size was calculated based on test power 80% and 95% confidence interval. Assuming that there were 150 during the research period, individuals with ACS received coronary artery intervention, and brain natriuretic peptide exhibited a positive prognostic value of 32.3% for contrast-induced nephropathy. Therefore, 104 people will make up the projected sample size when using the open Epi-Info Software [(6)]

Methods:

1) Complete history taking and thorough clinical examination.
2) ECG.
3) Echocardiography.
4) Serum cardiac -specific troponin.
5) Serum creatinine levels were assessed at baseline (before to angiography) and every day for at least three days following the procedure. If the serum creatinine increased, additional daily creatinine levels were evaluated until renal function was improving by >0.3 mg/dL from baseline on either of these first two measurements.
6) Brain Natriuretic Peptide (BNP): BNP levels were assessed in blood samples taken from consecutive patients during admission and prior to angiography Brain natriuretic peptide measurement is affordable, repeatable, and simple to complete. Monitoring cerebral natriuretic peptide is crucial and necessary for ACS patients.

Participants were divided into 2 groups: Group I included CIN sufferers and Group II included those who lack a CIN.

Ethical Consideration:

This study was ethically approved by the Institutional Review Board (IRB) of the Faculty of Medicine, Zagazig University. Written informed consent was obtained from all participants. This study was executed according to the code of ethics of the World Medical Association (Declaration of Helsinki) for studies on humans.

Statistical Analysis

The collected data were introduced and statistically analyzed by utilizing the Statistical Package for Social Sciences (SPSS) version 20 for windows. Qualitative data were defined as numbers and percentages. Chi-Square test and Fisher's exact test were used for comparison between categorical variables as appropriate. Quantitative data were tested for normality by Kolmogorov-Smirnov test. Normal distribution of variables was described as mean and standard deviation (SD), and independent sample t-test/Mann-Whitney test was used for comparison between groups. P value ≤0.05 was considered to be statistically significant.

RESULTS

The No-CIN group had 88 (84.6%) patients and CIN group had 16 (15.4%) patients (**Figure 1**).

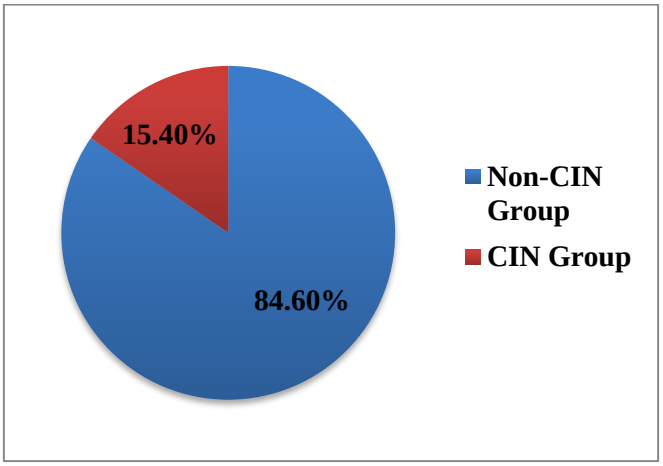

Figure (1): Pie chart showing distribution of the studied patients according to CIN.

Patients who had CIN were noticeably older than those who did not. The smoking compared to CIN, was substantially greater in Non-CIN. No discernible changes were found comparison of the genders of the two groupings or BMI (**Table 1**).

Table (1): Demographic data of the studied patients.

Variable	Non-CIN Group N=88 (84.6%)	CIN Group N=16 (15.4%)	P value
Age, years	60.59 ±12.29	72.22 ± 12.79	<0.001+
Smoking	42 (47.7%)	3 (18.8%)	0.031+
Male gender (n & %)	63 (71.6%)	10 (62.5%)	0.464
BMI, kg/m^2	27.85 ± 4.5	27.13 ± 4.4	0.354

CIN is contrast-induced nephropathy, Non-CIN is non-contrast- induced nephropathy and BMI is body mass index; *P<0.05 is statistically significant data is represented as meant SD and compared using independent sample t test.

The habit of smoking was highly significant higher among Non-CIN than CIN patients (**Figure 2**).

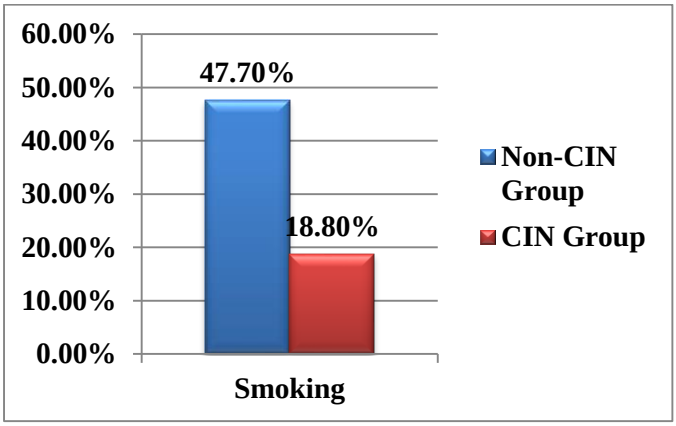

Figure (2): Simple bar chart showing the difference in smoking between two groups of patients.

There were no statistically substantial variation heart rate, systolic blood pressure, and diastolic blood pressure between the two groups (**Table 2 and Figure 3**).

Table (2): Baseline and vital data of the studied patients.

Variable	Non-CIN Group N=88 (84.6%)	CIN Group N=16 (15.4%)	P value
Heart rate (bpm)	74.25 ± 8.9	72.9 ± 4.6	0.485
Systolic blood pressure, mm Hg	130 ± 25	135 ± 32	0.257
Diastolic blood pressure, mm Hg	75 ± 14	74 ± 16	0.907

SBP: Systolic blood pressure, DBP: Diastolic blood pressure and There was statistically non-significant differences between both groups in heart rate, systolic or diastolic blood pressure.

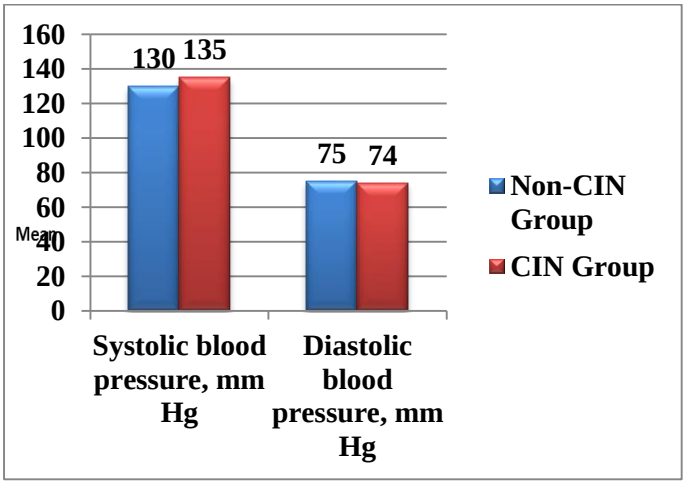

Figure (3): Means of Diastolic blood pressure and Systolic blood pressure in both groups.

Regarding baseline hs CRP and NT-pro BNP, statistically significant variations existed between the examined groups (both were considerably greater in the CIN group). Peak CK did not differ statistically significantly between the groups.-MB (**Table 3**).

Table (3): Cardiac Biomarkers of the studied patients in both groups.

Variable (Mean & Range)	Non-CIN Group N=88 (84.6%)	CIN Group N=16 (15.4%)	P-value
Peak CK-MB, ng/mL	33.6 (0.68 -425)	54.4 (3.2 -416)	0.31
hs-CRP, mg/L	7.5 ± 1.7	8.4 ± 1.6	0.014*
NT-pro BNP, pg/mL	754 (177.4-2164)	5979 (2282-9677)	<0.001*
BNP, pg/mL	284 (61-858)	695 (88-3800)	0.001
Peak Troponin T, ng/mL	1057 (934-1294)	1783 (1466-18960)	0.025

CK-MB: Creatine kinase-myocardial band, hs-CRP: high-sensitivity C-reactive protein and NT-pro BNP: N-terminal pro-brain natriuretic peptide.

Table 4 demonstrates demonstrated the CIN Group and the No-CIN Group differed in a manner that was statistically significant for BNP, pg/mL means and ranges with Sensitivity-Specificity% (73.9-73.7).

Table (4): BNP, pg/mL means and ranges of studied patients.

Variable	No-CIN Group N=88 (84.6%)	CIN Group N=16 (15.4%)	P value	Sensitivity-Specificity %
BNP, pg/mL	284 (61-858)	695 (88-3800)	<0.001	73.9-73.7

DISCUSSION

The patients two groups were separated for our study based on to how frequently CIN occurred; 88 (84.6%) patients were in the no-CIN group, while 16 (15.4%) patients were in the CIN group.

According to **Abdel-Ghany *et al.*** [7], we sought to examine the various CIN predictors, establish the CV/CrCl cutoff point, and assess the application of the CHA2DS2-VASC score in ST-elevation myocardial infarction (STEMI) patients for the prediction of CIN after PPCI. They asserted that their study's CIN incidence was comparable to other studies' to 13.5%.

The research by **Mehran *et al.*** [8], it had a 13.1% overall rate of CIN development. However, it was distinct from research on **Maioli *et al.*** [9], it had a 27.3% CIN development rate.

In researches evaluating CI-AKI prevalence, **Yuan *et al.*** [10] reported 22.7%, **Sun *et al.*** [11] reported 15.8% and **Marenzi *et al.*** [12] reported 19%.

In study of **Chong *et al.*** [13] patients with normal creatinine levels who got emergency PCI after an AMI, CI-AKI incidence was 7.3%. In the research of **Liu *et***

al. [14] 9.2% of STEMI patients had CI-AKI, it was discovered.

In our study, the male gender was 62.5%. This contradicts **Abdel-Ghany *et al.*** [7] who stated that Group II had much more female sex than male sex and that this was a powerful independent indicator of how CIN will progress. Also not the same as what was reported by **Ioannidis *et al.*** [15]. Female ovarian hormones, which have an impact on the renin-angiotensin system, may be to blame for this and blood flow to the kidneys [16].

In study of **Lucreziotti *et al.*** [17] Female gender was discovered to increase the danger of CI-AKI following PCI in AMI. Patients who had CIN were noticeably older than those who did not.

The current study's findings revealed statistically significant variations in baseline and NT-pro BNP levels across the studied groups, both of which were statistically considerably higher in the CIN group % (73.9-73.7) for BNP, pg/mL. Additionally, in this study's multivariate regression analysis, NT-Pro BNP >2149 pg/mL sustained substantial rise in CIN risk by 3.444 folds.

This is in harmony with **Li *et al*.** [18] who claimed that NT-proBNP or BNP is an effective biomarker for diagnosis of CI-AKI (AUC=0.81, SEN=0.73, and SPE=0.79). The finding is accurate for both BNP (AUC=0.78, SEN=0.69, and SPE=0.80) and NT-proBNP (AUC=0.82, SEN=0.77, and SPE=0.78).

This also agrees with **Kurtul *et al.*** [19] they wanted to know if patients receiving interventional therapy for Unstable angina/non-ST-segment elevation and ACS with ST-segment elevation (STE-ACS) (NSTE-ACS) had a different risk factor that predicted the development of CIN. They demonstrated that the level of NT-proBNP at admission is a trustworthy predictor of CIN in ACS patients receiving PCI.

Moreover, **Jarai *et al.*** [20] showed a connection between the level of (BNP) at admission and the occurrence of CIN after initial PCI in patients with STE-ACS.

Jarai *et al.* [20] have demonstrated that elevated BNP levels serve as a further independent predictor of CI-AKI, which in turn denotes a poor prognosis for STEMI [21].

Our results corroborate past research findings that acute heart failure patients with acute renal impairment who are admitted have considerably increased baseline BNP values within 48 hours [22]. A recent study also discovered a direct relationship between preoperative BNP readings and the chance of kidney injury following heart surgery [23].

Study of **Liu *et al.*** [14] indicated that 1800 pg/mL had the optimal NTproBNP cut-off value for detecting CIN, with 69% sensitivity and 70% specificity.

Simsek *et al.* [24] reported that low LVEF or elevated NT-proBNP were determined to be signs of cardiac dysfunction. They discovered a relationship between CI-AKI and cardiac dysfunction that is statistically significant. The marker found in the pro-BNP's N-terminal section rather than BNP because it appears to be more stable [25].

CONCLUSION

BNP or NT-proBNP might be able to predict CIN with accuracy.

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Conflicts of interest: There are no conflicts of interest, according to the authors.

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