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ORIGINAL ARTICLE

Impact of an Early Decrease in Systolic Blood Pressure on The Risk of Contrast-Induced Nephropathy after Percutaneous Coronary Intervention

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Background The early postprocedural period was thought to be the rush hour of contrast media excretion, causing rapid and prolonged renal hypoperfusion, which was the critical time window for contrast-induced nephropathy (CIN).

Methods 349 consecutive patients were enrolled into the study. The relation between an early postprocedural decrease in systolic blood pressure (SBP) and the risk of CIN was assessed using multivariate logistic regression.

Results A postprocedural decrease in SBP was observed in 63% of patients and CIN developed in 28 (8.0%) patients. The CIN group had a lower postprocedural SBP (114.5 ± 13.5 vs. 123.7 ± 15.6 mmHg, P = 0.003) and a greater postprocedural decrease in SBP (16.2 ± 19.1 vs. 5.9 ± 18.7 mmHg, P = 0.005) than the no-CIN group. ROC analysis revealed that the optimum cutoff value for the SBP decrease in detecting CIN was >10 mmHg (sensitivity 60.7%, specificity 59.5%, AUC = 0.66). Multivariate logistic regression analysis found that a postprocedural decrease in SBP >10 mmHg was a significant independent predictor of CIN (OR 2.368, 95%CI: 1.043–5.379, P = 0.039), after adjustment for other risk factors.

Conclusion An early moderate postprocedural decrease in SBP may increase the risk of CIN in patients undergoing PCI.

Keywords Contrast-induced nephropathy • Systolic blood pressure • Haemodynamic instability • Percutaneous coronary intervention

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Introduction

Contrast-induced nephropathy (CIN) is one of the most common major adverse events after percutaneous coronary intervention (PCI) and is associated with increased morbidity, short- and long-term mortality, and healthcare costs [1]. Risk factors for development of CIN include chronic kidney disease, large contrast volume, diabetes mellitus, advanced age, and especially periprocedural haemodynamic instability [2,3]. The early postprocedural period was thought to be the rush hour of contrast media excretion, causing rapid and prolonged renal hypoperfusion [4,5], which was the critical time window for CIN. Therefore, the decrease in blood pressure in the early phase after PCI may affect the development of CIN. The purpose of this study was to evaluate the impact of an early postprocedural decrease in SBP on CIN development.

Materials and Methods

Subjects

This prospective observational study was conducted at the Guangdong Cardiovascular Institute of Guangdong General Hospital, Guangdong Academy of Medical Sciences. All consecutive patients who underwent elective PCI between December 2010 and July 2012 were reviewed according to the institutional protocol. Criteria for exclusion included chronic peritoneal or haemodialysis treatment, a history of kidney transplantation, preprocedural treatment with intra-aortic balloon pump (IABP), emergency PCI, previous contrast media administration within two weeks, and periprocedural treatment with non-steroidal anti-inflammatory drugs, metformin, or other nephrotoxic drugs. Patients who died during PCI were also excluded. Finally, 349 consecutive patients who underwent elective PCI were included in the analysis.

Methods

The blood pressure at admission was measured as baseline. Postprocedural blood pressure was measured by the noninvasive electronic blood pressure monitor (Intellisense, HEM-7052) every hour within the first six hours after PCI. The patients lay supine for at least five minutes before blood pressure was taken, and three readings would be performed, the average value of latter two ones would be the final record. As with the patients treated with IABP, the postprocedural blood pressure readings were taken by the noninvasive electronic blood pressure monitor. The postprocedural decrease in SBP was defined as the difference between baseline and the average value of the postprocedural SBP measurements.

Congestive heart failure was defined as New York Heart Association class III/IV at admission. Hypotension was defined as SBP < 80 mmHg for one hour requiring inotropic support with medications and/or IABP within 24 hours periprocedurally. The estimated glomerular filtration rate (eGFR) was calculated using the abbreviated Modification of Diet in Renal Disease (MDRD) formula [6]. Percutaneous coronary intervention was performed with use of a low-osmolar, nonionic contrast medium. The details of the PCI procedure and the use of IABP, inotropic drugs, beta-blockers, angiotensin-converting enzyme inhibitors, and diuretics were left to the discretion of the cardiologists. Patients received a continuous intravenous infusion of isotonic saline at a rate of 1 mL/kg/h (0.5 mL/kg/h in case of left ventricular ejection fraction <40% or severe congestive heart failure) for 2–12 h before and 6–24 h after the procedure. The primary endpoint was CIN, defined as an increase in serum creatinine $\geq$0.5 mg/dL and/or $\geq$25% from baseline within 48 hours after the administration of contrast medium [7]. The ethics committee of Guangdong General Hospital approved this study and all patients gave written, informed consent.

Statistical Analysis

Statistical analysis was performed using Statistical Analysis Software (SAS) version 9.3 (SAS Institute, Inc., Cary, NC). Baseline characteristics were compared between the patients with and without CIN. Differences in characteristics between groups were analysed using the Student *t*-test (for continuous variables with normal distribution), Wilcoxon rank sum test (for continuous variables with skewed distribution), or the Pearson chi-square test or Fisher's exact test (for categorical variables). Receiver operating characteristic (ROC) curve analysis was conducted and the Youden index was used to determine the best cutoff value of the change in SBP for predicting CIN. Multivariable logistic regression analysis was used to assess variables independently associated with CIN. Two sided $P < 0.05$ was considered statistically significant.

Results

Clinical Characteristics of Patients

In the overall population of 349 patients, 65 (18.6%) were female, 219 (62.8%) had hypertension, and 104 (29.8%) had diabetes mellitus. The mean age was 65.0 $\pm$ 10.5 years, and the mean eGFR was 74.0 $\pm$ 25.7 mL/min/1.73m^2. A total of 28 patients (8.0%) developed CIN. There were significant clinical differences between subjects with and without CIN, as shown in Table 1.

A postprocedural decrease in SBP was recorded in 63% of patients, with an average value of 6.7 $\pm$ 18.8 mmHg. There were no significant differences in SBP at admission between patients with and without CIN (130.8 $\pm$ 15.8 vs. 129.5 $\pm$ 18.8 mmHg, $P = 0.738$). However, in comparison with patients without CIN, patients with CIN had a lower postprocedural SBP (114.5 $\pm$ 13.5 vs. 123.7 $\pm$ 15.6 mmHg, $P = 0.003$), and a greater postprocedural decrease in SBP (16.2 $\pm$ 19.1 vs. 5.9 $\pm$ 18.7 mmHg, $P = 0.005$), with a higher incidence of congestive heart failure. One patient had preprocedural hypotension, and one patient experienced postprocedural hypotension because of acute heart failure attack at the end of PCI. The patients with CIN experienced a more severe postprocedural decrease in SBP, as shown in Figure 1. No significant differences between patients with and without