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Intravascular Ultrasound Guidance to Minimize the Use of Iodine Contrast in Percutaneous Coronary Intervention

The MOZART (Minimizing cOntrast utiliZation With IVUS Guidance in coRonary angioplasTy) Randomized Controlled Trial

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ABSTRACT

OBJECTIVES The aim of this study was to evaluate the impact of intravascular ultrasound (IVUS) guidance on the final volume of contrast agent used in patients undergoing percutaneous coronary intervention (PCI).

BACKGROUND To date, few approaches have been described to reduce the final dose of contrast agent in PCIs. We hypothesized that IVUS might serve as an alternative imaging tool to angiography in many steps during PCI, thereby reducing the use of iodine contrast.

METHODS A total of 83 patients were randomized to angiography-guided PCI or IVUS-guided PCI; both groups were treated according to a pre-defined meticulous procedural strategy. The primary endpoint was the total volume contrast agent used during PCI. Patients were followed clinically for an average of 4 months.

RESULTS The median total volume of contrast was 64.5 ml (interquartile range [IQR]: 42.8 to 97.0 ml; minimum, 19 ml; maximum, 170 ml) in the angiography-guided group versus 20.0 ml (IQR: 12.5 to 30.0 ml; minimum, 3 ml; maximum, 54 ml) in the IVUS-guided group ($p < 0.001$). Similarly, the median volume of contrast/creatinine clearance ratio was significantly lower among patients treated with IVUS-guided PCI (1.0 [IQR: 0.6 to 1.9] vs. 0.4 [IQR: 0.2 to 0.6, respectively; $p < 0.001$). In-hospital and 4-month outcomes were not different between patients randomized to angiography-guided and IVUS-guided PCI.

CONCLUSIONS Thoughtful and extensive use of IVUS as the primary imaging tool to guide PCI is safe and markedly reduces the volume of iodine contrast compared with angiography-alone guidance. The use of IVUS should be considered for patients at high risk of contrast-induced acute kidney injury or volume overload undergoing coronary angioplasty. (Minimizing cOntrast utiliZation With IVUS Guidance in coRonary angioplasTy [MOZART]; NCT01947335) (J Am Coll Cardiol Intv 2014;7:1287–93) © 2014 by the American College of Cardiology Foundation.

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ABBREVIATIONS AND ACRONYMS

CI-AKI = contrast-induced acute kidney injury

IVUS = intravascular ultrasound

IQR = interquartile range

PCI = percutaneous coronary intervention

Contrast-induced acute kidney injury (CI-AKI) is a potential complication of diagnostic and therapeutic angiographic procedures. Almost unanimously, previous studies have shown that CI-AKI is associated with worse clinical outcomes (1). It remains debatable, however, whether CI-AKI is solely a marker for future morbimortality or, conversely, it is also causally implicated in the occurrence of adverse events (1,2).

A number of strategies have been tested to reduce the incidence of CI-AKI. Vigorous fluid administration before and after the procedure is considered the most important prophylactic scheme for patients at risk of CI-AKI (3,4). Multiple other preventive measures have been evaluated in clinical studies, but none has been widely adopted, and, in practice, CI-AKI persists as a major clinical problem for patients undergoing angiographic procedures (4–13).

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Although the incidence of CI-AKI is modulated by several clinical characteristics, the volume of iodine contrast seems to be a major factor leading to CI-AKI, independently of the baseline risk profile (14–18). Curiously, thus far, few approaches have been described to reduce the primary cause of CI-AKI after PCI, namely, the contrast agent dose (19–22). It is of note that, in addition to be of potential benefit for patients at risk of CI-AKI, strategies to decrease the use of contrast may also be valuable for other subgroups of patients, such as those at risk of volume overload.

Intravascular ultrasound (IVUS) is largely used to guide percutaneous coronary interventions (PCIs) (23). Because of its ability to accurately measure lumen, plaque, and vessel dimensions, it is possible that IVUS might serve as an alternative tool to angiography in many steps during PCI. We therefore hypothesized that IVUS imaging during coronary angioplasty may lead to a reduced use of contrast media. The present report describes the primary endpoint analysis of the MOZART (Minimizing cOntrast utiliZation With IVUS Guidance in coRonary angioplasTy) randomized controlled trial study, which evaluated the impact of thorough IVUS guidance on the final dose of contrast agent used in patients undergoing PCI.

TABLE 1 Guidelines to Reduce the Volume of Contrast During Percutaneous Coronary Angioplasty (To Be Applied in Both Study Arms)

Awareness of the baseline creatinine clearance to ensure that contrast use does not to exceed a volume-to-creatinine clearance ratio of 2. All actions should be taken to never exceed a ratio of 3, whenever possible.
Detailed analysis of the diagnostic coronary angiography to plan the interventional procedure (e.g., choice for best projections, selection of treatment strategies) and anticipate potential complications.
If the diagnostic coronary angiography was performed recently and of good quality, consider avoiding any baseline angiography during percutaneous coronary intervention. In this case, the diagnostic angiography, displayed on an auxiliary video monitor, should be used as a baseline reference.
Extensive use of auxiliary video monitors with reference images of the target vessel anatomy during the procedure.
Extensive use of online x-ray (noncontrast) stent enhancement post-processing techniques.
Small-diameter guiding catheters (5- or 6-F) with no side holes.
Small-volume syringes for contrast injection (3 or 5 ml).
Extensive use of diluted contrast during the procedure (at least 1:1).
All contrast injections must be done during acquisition (not fluoroscopy) for better visualization of target segments and to allow for repeat video loops.
Avoid unnecessary "puff testing" of contrast.
Liberal use of high acquisition rates. Increased acquisition rates (i.e., >15 frames per second) may be used during the procedure to improve angiographic image quality, particularly in patients with high heart rate or for fast-moving target segments (e.g., midright coronary artery or midleft circumflex artery).
Before insertion of any new interventional material into the guiding catheter (e.g., balloons, stents), caution must be taken to make sure that the lumen of the catheter is free of contrast.

METHODS

PATIENT POPULATION. Patients 18 years of age or older scheduled for PCI were considered for enrollment in the MOZART trial. Included patients were at high risk of CI-AKI or volume overload, according to the presence of ≥1 of the following criteria: 1) older than >75 years of age; 2) diabetes; 3) acute ischemic syndrome needing urgent or emergent PCI; 4) creatinine clearance <60 ml/min/1.73 m^2 or a single remaining kidney or previous renal transplantation; 5) congestive heart failure, pulmonary congestion, severe left ventricular dysfunction (ejection fraction <45%), cardiogenic shock, or intra-aortic balloon pumping. Angiographic eligibility required that all target vessels be amenable to IVUS imaging at baseline (i.e., before any balloon dilation), as judged by an experienced interventionalist. Exclusion criteria included use of iodinated contrast agents <72 h or other nephrotoxic agents <7 days before procedure, known allergy to contrast agents, and unstable or unknown renal function before PCI. The study was approved by the institutional review board, and signed written informed consent was obtained from every patient.

STUDY DESIGN, TREATMENT PROTOCOL, AND FOLLOW-UP. All patients at high risk of CI-AKI received intravenous hydration for 12 h pre- and 12 h post-PCI. The interventional plan was left to the discretion of the operator, but regardless of the allocated arm, operators were strongly recommended to follow strict strategies to reduce the total volume of contrast for all patients, as summarized in Table 1.