Journal of Clinical and Interventional Cardiology

Kern JA et al., J Clin Intervent Cardiol. 2018, 3(1):1-3
http://dx.doi.org/10.14312/2399-8202.2018-1

NobleResearch
An Open Access Publisher
www.nobleresearch.org

Case report

Open Access

Novel approaches to percutaneous intervention in stage IV kidney disease

Joseph A Kern[1], Miryea Cisneros[1], Sandeep Nathan[1] and John E.A. Blair[1,*]

[1] Department of Medicine, Section of Cardiology, Pritzker School of Medicine, The University of Chicago Medicine, Chicago, IL 60637, USA

Abstract

Coronary artery disease (CAD) is common in patients with chronic kidney disease (CKD). We report the case of a 53-year-old diabetic male with stage IV CKD who presented to the emergency department with unstable angina. He underwent coronary angiography utilizing bilateral radial artery access and simultaneous injection of the right- and left-coronary systems during rotational coronary angiography to identify a high-grade mid-right coronary artery lesion. The lesion was treated using intravenous ultrasound to facilitate minimal-contrast percutaneous intervention and the patient avoided hemodialysis post-procedure. This case demonstrates a novel approach to coronary angiography and percutaneous intervention in patients with CKD.

Keywords: contrast-induced nephropathy; percutaneous intervention; intravenous ultrasound; coronary artery disease; chronic kidney disease

Introduction

Coronary artery disease (CAD) is common in patients with chronic kidney disease (CKD) [1], however performing coronary angiography and intervention may place these patients at risk for contrast-induced nephropathy (CIN). We describe a case where three techniques were used in a patient with severe CKD with unstable angina, limiting contrast medium (CM) use and preserving renal function.

Case presentation

A 53-year-old male with type II diabetes mellitus, hyperlipidemia, hypertension, and stage IV CKD secondary to systemic lupus erythematous, presented to the emergency department with substernal chest pressure consistent with 12 h of unstable angina. Blood pressure was 106/59 mmHg, heart rate 69 beats per minute, respirations 16 breaths/min, and oxygen saturation 97% on room air. Ausculation revealed a regular rate and rhythm, normal first and second heart sounds, no murmurs, and clear lung fields. He had intact distal pulses and no peripheral edema. Electrocardiogram revealed no ischemic changes, and laboratory analysis revealed blood urine nitrogen 47 mg/dL, serum creatinine (sCr) 4.3 mg/dL, estimated glomerular filtration rate (GFR) 18.2 mL/min/1.73m^2, and troponin I 0.11 ng/mL. Echocardiography revealed ejection fraction of 58% with inferior, inferoseptal, and inferolateral wall hypokinesis. He had presented similarly one month prior but declined invasive angiography out of fear of CIN. During the hospital stay, sCr rose to 5.6, but after avoidance of nephrotoxic medications and aggressive hydration with 1 mL/kg/h 0.9% normal saline for 12 h, sCr fell to 4.9 mg/dL with serum bicarbonate 23 mmol/L and anion gap 15 mmol/L, and he proceeded to cardiac catheterization.

Under conscious sedation, the patient underwent left- and right- radial access with 6 French Slender sheaths (Terumo, Japan), left ventricular end-diastolic pressure (LVEDP) was measured at 20 mmHg with a 5 French pigtail catheter, and the left main and right coronary arteries were cannulated using standard 5 French Judkins catheters. Additional fluid was administered at 1.5 mL/kg/hour and continued until 4 h post-procedure according to a recent randomized controlled trial in which fluid administration was based on LVEDP [2], and both catheters were connected to the manifold using a 3-way stopcock and a male-to-male connector (Figure 1). With the stopcock flipped downwards, simultaneous injections and dual-axis

***Corresponding author:** John E. A. Blair, M.D., The University of Chicago Medicine, 5841 S. Maryland Avenue, MC 5076, Chicago, IL 60637, United States. Tel.: 773-834-1692; Fax: 773-834-2184; Email: jblair2@medicine.bsd.uchicago.edu

Received 19 December 2017 *Revised* 30 January 2018 *Accepted* 13 February 2018 *Published* 22 February 2018

Citation: Kern JA, Cisneros M, Nathan S, Blair JEA. Novel approaches to percutaneous intervention in stage IV kidney disease. J Clin Intervent Cardiol. 2018; 3(1):1-3. DOI: 10.14312/2399-8202.2018-1

rotational coronary angiography was performed (Xper Swing, Philips, Netherlands) with 10 mL iodixanol contrast (Visapaque). Coronary angiography revealed a 30% diffuse lesion in the proximal left circumflex artery and a focal 80% lesion in the mid-right coronary artery (RCA) (Figure 2a & b). A 6 French JR-4 guide catheter was advanced through the right radial artery and seated in the right coronary ostium. After ensuring adequate anticoagulation with heparin, and using the prior angiogram as a guide, the lesion was wired with a 0.014" ProWater wire (Asahi Intecc, Japan), and an Eagle Eye Platinum Intravenous Ultrasound (IVUS) device (Volcano Corp, Phillips Holding USA Inc.) was advanced across the lesion, revealing a 2.7 × 3.0 mm distal reference and a 2.9 × 3.2 mm proximal reference with a stenotic minimal luminal area of 2 mm^2 (Figure 2e). This IVUS catheter was removed and a 2.75 × 12.0 mm Xience (Abbott, USA) stent was deployed at 13 atm, and post-dilated with a 3.0 × 8.0 mm NC Trek balloon at 16 atm (Abbott, USA) (Figure 2c & d). Post-intervention IVUS images revealed a well-expanded, well-apposed stent without rupture or dissection (Figure 2f). Total contrast used was 35 mL. He required intravenous loop diuretics for lower extremity edema that developed three days following cardiac catheterization. Creatinine slowly increased and peaked at 6.1 mg/dL on post-procedure day 8 and returned to 5.5 mg/dL on post-procedure day 10 (Figure 3), when he was discharged in stable condition.

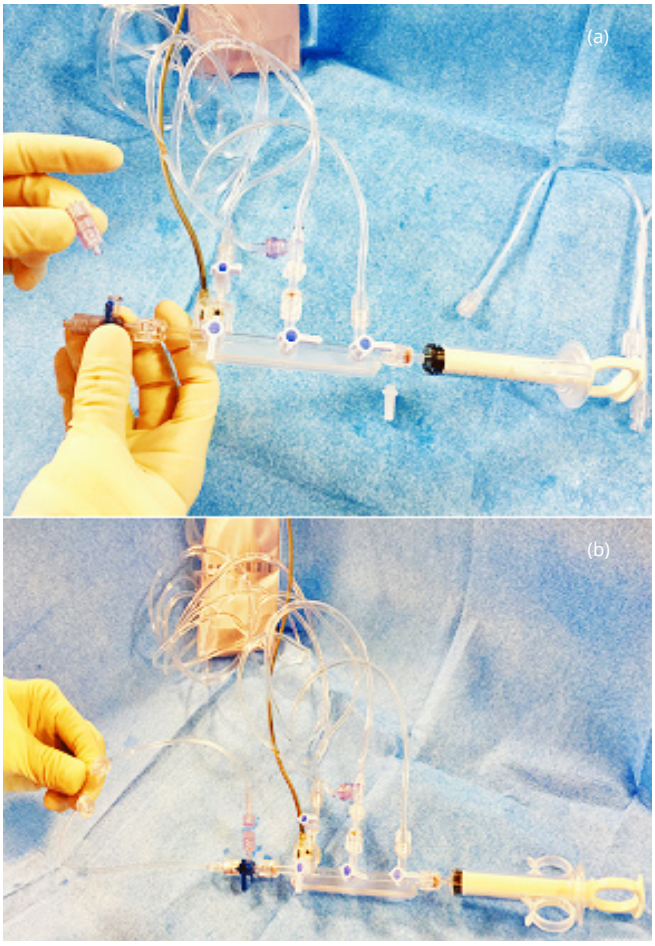

Figure 1 Standard 5 French catheters connected through a 3-way stopcock method. (a) A three-way stopcock with a male-to-male connector will; (b) allow for connection of extension tubes to be attached to the ends of both catheters. The three-way stopcock is placed in the downward position prior to injection of contrast to allow simultaneous flow through both tubes.

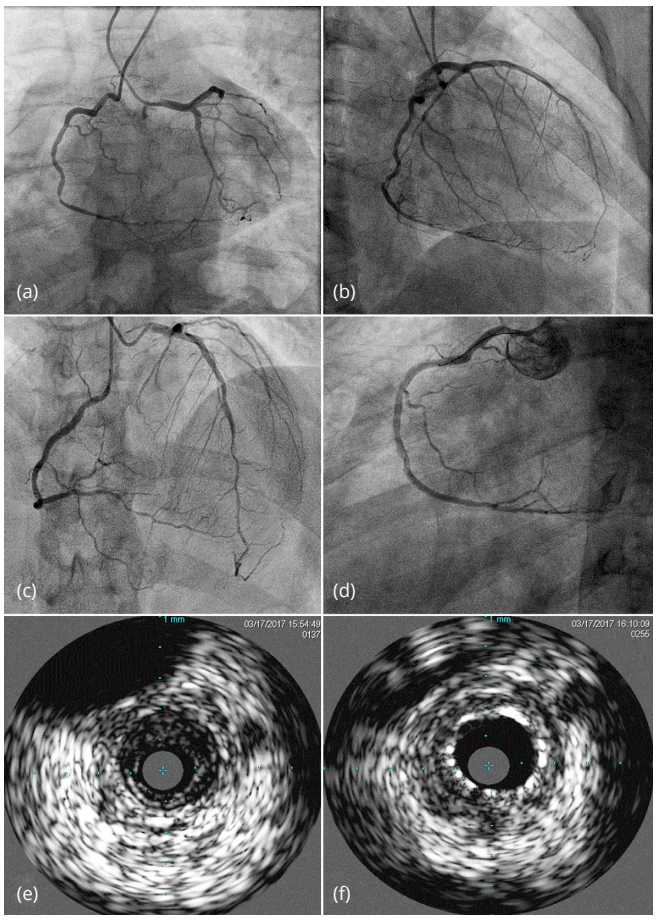

Figure 2 Low contrast approaches to Percutaneous Coronary Intervention (PCI) through simultaneous injection rotational angiography and Intravascular Intravenous Ultrasound (IVUS). Detailed angiographic projections provided from rotational angiography at (a) Left Anterior Oblique Caudal; (b) Right Anterior Oblique Caudal; (c) Right Anterior Oblique Cranial angulation; Angiography of the right coronary artery post-stent (d); Intravascular ultrasound before (e) and after (f) deployment of a 2.75 x 12mm Xience (Abbott, USA) stent.

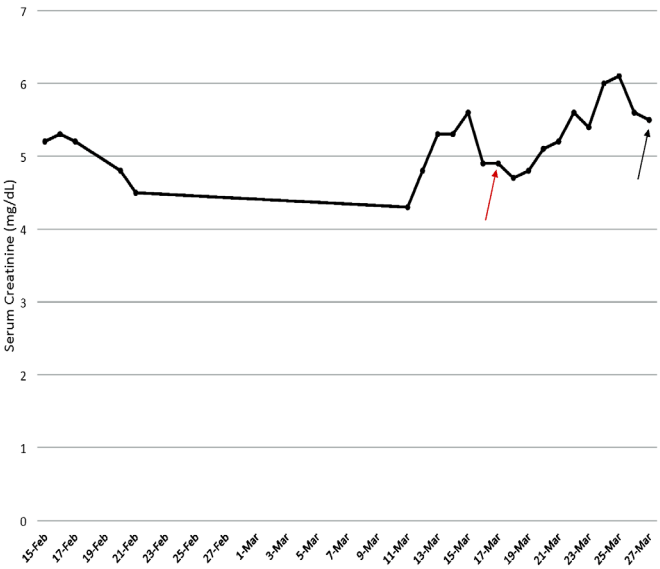

Figure 3 Plot of the patient's sCr from a previous hospitalization one month prior through ten days post-procedure. At his previous hospitalization, he presented with a sCr of 5.2mg/dL and was admitted on March 11 with sCr of 4.3mg/dL. One day prior to catheterization sCr was at 4.9mg/dL, remained at this value on the day of the procedure (red arrow) and fell to 4.7mg/dL one day post-procedure. sCr rose again to 6.1mg/dL on post-procedure day eight, before falling back down to 5.5mg/dL on post-procedure day ten (black arrow).

Discussion

This case illustrates an innovative approach to percutaneous intervention in a patient at high risk for CIN. CIN is commonly defined as an absolute increase in sCr of 0.5mg/dL above baseline or a decrease in GFR of greater than 25%, 48-72 h following the introduction of contrast medium [3]. Risk factors for CIN include older age, baseline renal dysfunction, diabetes mellitus, anemia and blood loss, dehydration, use of high CM, and presence of shock or congestive heart failure [3]. Here we show bilateral radial access for simultaneous injection of both coronary ostia while using rotational angiography for the diagnostic angiogram, the use of IVUS for percutaneous coronary intervention (PCI), and hemodynamic-guided fluid administration in order to minimize the risk of CIN. Our patient was at exceptionally high risk for CIN, and although sCr did increase by 0.5 mg/dL, this increase occurred 8 days after CM administration and may not have been related to his angiogram and PCI. Importantly, he did not require hemodialysis.

Radial artery access for PCI has many advantages over femoral access, including fewer complications and improved post-operative mobility for patients [4]. Recently, the radial approach itself has been associated with reduced risk of CIN across all risk strata in patients undergoing PCI for acute coronary syndromes [5]. Proposed mechanisms for reduced CIN incidence using the radial approach include reduced bleeding and renal athero-embolism. Rotational angiography, in the place of standard angiography, allows for multiple angiographic views with a single coronary injection without compromising anatomical detail [6]. We further modified this approach by cannulating both left and right coronary systems, and modifying the manifold in order to inject both ostia while performing rotational angiography, using just 10 cc for an entire angiogram. The use of IVUS allowed for accurate sizing of the reference vessel and lesion length before and optimization after stent deployment. The use of IVUS has been evaluated in patients with CKD without contrast at all [7]. We used a hemodynamic-guided intravenous hydration strategy based on LVEDP, whereby 0.9% normal saline is administered at 5 mL/kg/h for LVEDP < 13 mmHg, 3 mL/kg/h for LVEDP 13-18 mmHg, and 1.5 mL/kg/h for LVEDP > 18 mmHg peri-procedurally, which has been associated with superior renal and clinical outcomes as compared to standard hydration techniques [2]. The concurrent use of these four techniques, in addition to standard withholding of nephrotoxic agents [8], represents an innovative approach to PCI that allows for limited use of CM and adequate hydration which may be utilized in patients at high risk for CIN.

Conclusion

Advanced chronic kidney disease poses a significant risk for CIN in patients undergoing coronary angiography and intervention. Use of radial artery access, hemodynamic-guided administration of intravenous hydration, simultaneous injection rotational angiography, and IVUS for the coronary intervention may substantially reduce contrast medium use and improve renal outcomes in those patients at risk for CIN.

Conflicts of interest

Authors declare no conflicts of interest.

References

[1] Turak O, Afsar B, Siriopol D, Yayla C, Oksuz F, et al. Severity of coronary artery disease is an independent risk factor for decline in kidney function. Eur J Intern Med. 2016; 33:93–97.

[2] Brar SS, Aharonian V, Mansukhani P, Moore N, Shen AYJ, et al. Hemodynamic-guided fluid administration for the prevention of contrast-induced acute kidney injury: The POSEIDON randomised controlled trial. Lancet. 2014; 383(9931):1814–1823.

[3] Mehran R, Nikolsky E. Contrast-induced nephropathy: Definition, epidemiology, and patients at risk. Kidney Int Suppl. 2006; 69(100):S11–15.

[4] Kumar AJ, Jones LE, Kollmeyer KR, Feldtman RW, Ferrara CA, et al. Radial artery access for peripheral endovascular procedures. J Vasc Surg. 2017; 66(3):820–825.

[5] Andò G, Cortese B, Russo F, Rothenbühler M, Frigoli E, et al. Acute kidney injury after radial or femoral access for invasive acute coronary syndrome management: AKI-MATRIX. J Am Coll Cardiol. 2017; 69(21):2592–2603.

[6] Ali ZA, Galougahi K, Nazif T, Maehara A, Hardy MA, et al. Imaging- and physiology-guided percutaneous coronary intervention without contrast administration in advanced renal failure: A feasibility, safety, and outcome study. Eur Heart J. 2016; 37(40):3090–3095. (Article PubMed)

[7] Hudson PA, Klein AJ, Kim MS, Wink O, Hansgen A, et al. A novel dual-axis rotational coronary angiography evaluation of coronary artery disease–case presentation and review. Clin Cardiol. 2010; 33(7):E16–19.

[8] Bashore TM, Balter S, Barac A, Byrne JG, Cavendish JJ, et al. 2012 American College of Cardiology Foundation/Society for Cardiovascular Angiography and Interventions expert consensus document on cardiac catheterization laboratory standards update: A report of the American College of Cardiology Foundation Task Force on Expert Consensus documents developed in collaboration with the Society of Thoracic Surgeons and Society for Vascular Medicine. J Am Coll Cardiol. 2012; 59(24):2221–2305.