When calcium helps: percutaneous coronary intervention without contrast medium in an elderly female patient with renal insufficiency and unstable angina

Quando o cálcio ajuda: intervenção coronária percutânea sem o uso de contraste em paciente idosa com insuficiência renal e angina instável

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ABSTRACT – The use of iodinated contrast media in coronary procedures may lead to contrast-induced nephropathy – particularly in older adults, diabetic individuals and patients with previous renal disease – and increase morbidity and mortality. There is no specific treatment for this condition; therefore, use of low contrast volumes and previous hydration remain the best prevention strategies. A case of percutaneous coronary intervention without contrast agent administration, involving an elderly female patient with chronic renal insufficiency and stable angina, is described. Intravascular ultrasound was used for optimal stent deployment.

Keywords: Angioplasty; Stents; Renal insufficiency, chronic; Acute coronary syndrome; Contrast media

INTRODUCTION

The use of iodinated contrast media in diagnostic and therapeutic procedures may cause acute renal insufficiency. Contrast-induced nephropathy is defined as an increase by 0.5mg/dL or over 25% in baseline serum creatinine levels, within 72 hours of contrast administration.¹ This nephropathy is a major cause of kidney failure in hospitalized patients, with an estimated prevalence of 12%. It leads to longer hospital stay, increased medical costs and higher risk of death as compared to non-affected patients.² Older adults, patients suffering from diabetes, previous renal dysfunction, heart failure, dehydration or multiple myeloma, and on concomitant use of nephrotoxic drugs, are at a higher risk.³ Intra-arterial contrast medium infusion is associated with a 2.2-fold increased risk of nephropathy as compared to intravenous infusion.⁴

The best management aims at disease prevention, since there is no specific treatment for the condition. Several strategies have been proposed; however, only the use
of low contrast volumes associated with intravenous administration of saline solution has proved to be effective. Patients with creatinine clearance <60mL/minute requiring diagnostic catheterization must receive 0.9% saline solution at 1mL/kg/hour (or 0.5mL/kg/hour for those with left ventricular dysfunction) for 6 to 12 hours prior to and 12 to 24 hours after the procedure. Contrast volume should be kept low, and low osmolality or iso-osmolar agents are preferred for being equally effective and less likely to induce nephropathy. Contrast medium volume to creatinine clearance ratio greater than 2.62 is an independent predictor of contrast-induced nephropathy. Also, volume depletion should be avoided and further procedures requiring contrast material delayed for 72 hours to 10 days in patients who developed nephropathy.

A case of percutaneous coronary intervention (PCI) without contrast agent administration, performed on an elderly female patient suffering from chronic renal insufficiency and unstable angina, is described. Intravascular ultrasound (IVUS) guidance was used for optimal stent deployment.

CASE REPORT

An 83-year-old female patient suffering dyslipidemia and chronic kidney disease not requiring dialysis (estimated creatinine clearance, 36mL/min) was referred for invasive risk stratification 5 days after an episode of non-ST elevation myocardial infarction (NSTEMI). She was using acetylsalicylic acid 100mg/day, clopidogrel 75mg/day, simvastatin 20mg/day, enalapril 20mg/day, and carvedilol 25mg/day; no appropriate fluid therapy had been implemented. Electrocardiography (ECG) revealed sinus rhythm, anterosuperior fascicular block, and changes in anterior wall repolarization.

Intravenous fluid therapy with 0.9% saline solution was started upon admission and maintained for 6 hours prior to diagnostic catheterization. The procedure findings were as follows: right-dominant coronary circulation, right coronary artery with parietal irregularities and grade 1 collateral circulation to the left coronary artery, no significant obstruction of the left main coronary artery, subocclusive calcified plaque on proximal to mid-third of the left anterior descending artery and left circumflex artery with parietal irregularities (Figure 1). Left ventriculography revealed normal end-diastolic volume and moderate anteropapical hypokinesia. Total volume of low-osmolality contrast medium injected was 40mL.

Grade 3 renal insufficiency precluded ad hoc intervention. Instead, the medical team decided to admit the patient to the hospital, aiming to perform intravenous fluid therapy (0.9% saline solution, 0.5mL/kg/hour). Typical, severe precordial pain recurred on the second day, with partial response to continuous intravenous infusion of nitroglycerine. Serum creatinine levels maintained at 1mg/dL and emergency PCI was undertaken.

Left coronary catheterization was performed using a 6 Fr EBU 3.5 guide catheter (Medtronic, Minneapolis, USA) and a 0.014-inch guidewire. Images from a previous coronary angiography were used as reference. Estimated lesion length was 22mm; proximal and distal reference vessel diameters were 3.5mm and 2.75mm, respectively. Following pre-dilation with a 3.0x12mm balloon at 16atm, a 3.0x24mm stent (Xience Prime®, Abbott Vascular, Illinois, USA) was advanced until its medial portion was aligned with the calcification, which marked the most critical point of the lesion, observed in previously obtained images. Stent deployment was performed at 8atm and a 1:1 balloon to proximal artery ratio achieved. A waist was observed in the guide balloon during dilation, confirming its adequate position, and was resolved with the progressive increase of the inflation pressure. A 3.5x8mm non-compliant balloon was then advanced and inflated at 25atm, avoiding the distal and proximal stent edges (Figure 2).

An IVUS catheter revealed strut malapposition at the proximal edge of the stent, with no signs of edge dissections. Another post-dilation was performed with a non-compliant balloon in the poorly expanded portion. Control IVUS images showed a well-expanded stent in its full length (Figure 3). No contrast medium was used during the procedure. The patient was referred to the Coronary Care Unit, asymptomatic and with no further changes on ECG. The myocardial necrosis markers were below the reference range and serum creatinine levels remained stable (1mg/dL).

DISCUSSION

Percutaneous coronary intervention guided by methods other than contrast medium administration, such as IVUS, is a procedure rarely performed and reserved for patients with advanced renal failure. It should be performed by very skilled and experienced operators. Most interventional procedures performed without the use of iodinated contrast agents described to date involve blood vessels other than the coronary arteries. Cook and Rees successfully performed intravascular ultrasound-guided angioplasty in patients with severe allergic reaction to contrast medium. Percutaneous coronary intervention guided by methods other than contrast medium administration, such as IVUS, is a procedure rarely performed and reserved for patients with advanced renal failure. It should be performed by very skilled and experienced operators. Most interventional procedures performed without the use of iodinated contrast agents described to date involve blood vessels other than the coronary arteries. Cook and Rees successfully performed intravascular ultrasound-guided angioplasty in patients with severe allergic reaction to contrast medium. PCI using low volume of or zero contrast medium has been described. However, the best anterograde flow assessment strategy remains to be determined. Okura et al. used IVUS to determine stent size and expansion, and a Doppler guidewire to assess anterograde flow. Results of the MOZART (Minimizing cOntrast utilZAtion with IVUS guidance in coRonary angioplasty) trial suggested that IVUS-guided PCI allows further reduction of contrast volume when compared to angiography-guided procedures. IVUS-guided PCI was thought to be effective and safe, did not require increased use of stents, and was not associated with an increase in adverse events in high-risk patients over a 12-month follow-up.
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**Figure 1.** Coronary cineangiography upon admission. (A, B and C) Subocclusive lesion on left anterior descending artery (proximal to mid segment). (D) Grade 1 collateral circulation from right to left coronary artery. (E) Detailed view of left anterior descending artery showing calcium on the most critical site of disease.

**Figure 2.** Coronary intervention. (A) 0.014-inch guidewire advanced through the lesion; calcium was used to guide stent positioning and deployment. (B) Predilation with a 3.0x12mm balloon. (C and D) Positioning and deployment of a 3.0x24mm stent. (E) Post-dilation with a 3.5x8mm balloon (proximal stent edge). (F) Angiographic control of stent positioning in the left anterior descending artery.
The feasibility, safety and clinical applicability of PCI procedures not requiring contrast agents, such as IVUS and fractional flow reserve (FFR) measurement, was investigated in a study involving 31 patients with advanced renal insufficiency. Successful outcomes were reported in all cases, with no severe adverse cardiovascular events or further deterioration of renal function. Alternative, non-iodinated contrast agents, such as gadolinium and carbon dioxide, may also be employed, albeit with some compromise in image quality and higher radioactive load. The use of gadolinium is restricted in renal failure patients.

In the hands of experts, PCI without contrast agent administration is feasible and safe; still, the procedure should be reserved for patients with advanced kidney insufficiency and favorable anatomy. Intravenous ultrasound guidance is recommended to optimize stent positioning, confirmation and deployment, and may be combined with FFR to assess the result. Given the growing number of patients with renal failure undergoing tests with contrast agents, novel approaches must be pursued and supported by appropriate resources and equipment.

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None.

**CONFLICT OF INTEREST**

The authors declare no conflicts of interest.

**REFERENCES**


