

CASE REPORT



## Gadolinium-based coronary angiography in a patient with prior known anaphylaxis to iodine-based dye

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### ABSTRACT

Gadodiamide is a gadolinium-based chemical element that is considered safe and well tolerated in patients without renal dysfunction and is therefore routinely used as a contrast agent in magnetic resonance imaging. Although radio-opaque, it is not frequently used for coronary angiography due to its less than optimal image quality and prohibitive cost. Our center's previous experience was less than satisfactory but the addition of a power injection system yielded good quality diagnostic images. We report a case of 63 years old male with a known history of severe, life-threatening anaphylactic reaction to previous iodinated dye presenting with persistent angina despite optimal medical therapy. Coronary and bypass graft angiography was performed using 24 cc of undiluted Gadodiamide (OMNISCAN) with a power injector (ACIST®) without any incidents or premedication with an interpretable angiogram.

### ARTICLE HISTORY

Received 7 October 2020  
Accepted 10 February 2021

### KEYWORDS

Angiography; complication; gadolinium use; iodine contrast allergy; PCI complication; percutaneous coronary intervention; stenting; ventricular fibrillation

## 1. Introduction

Conventional X-ray coronary angiography using iodinated contrast media is the gold standard technique for the diagnosis of coronary artery disease and for the determination of therapeutic strategies including percutaneous coronary intervention. However, an anaphylactic reaction to the iodinated contrast media can be life-threatening. Gadolinium-based contrast media have been developed to improve the quality of magnetic resonance imaging (MRI) and are considered safer and less nephrotoxic than the iodinated agents. Although radio-opaque, it is not frequently used for coronary angiography due to its less than optimal image quality, limited allowance per patient per study, minimal risk of ventricular arrhythmias, and prohibitive cost. There are only a few studies of using gadolinium for coronary angiography have been reported. Here we report another case of prior history of anaphylactic reaction to iodinated contrast using gadolinium for evaluation of coronaries during coronary angiography.

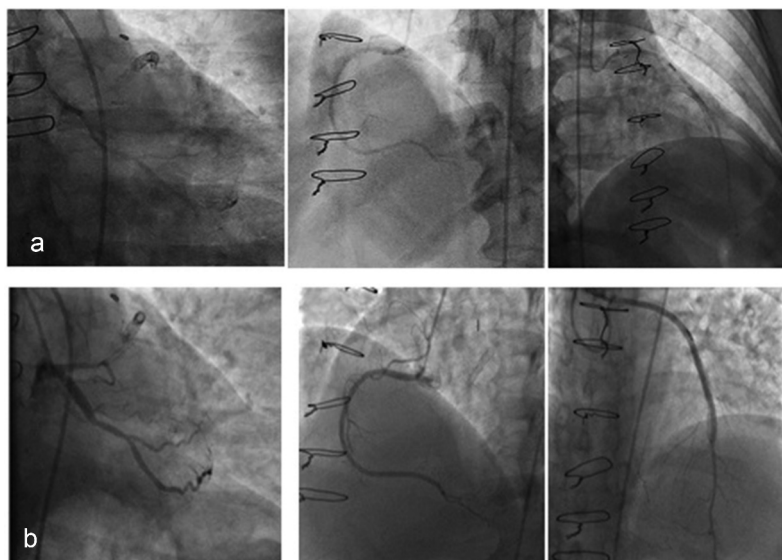
## 2. Case presentation

We present the case of a 63-year-old female with prior percutaneous revascularizations after a single vein bypass graft to the left anterior descending artery, presented with Canadian Cardiovascular Society (CCS)

Angina Grade III. Physical examination and laboratory were unremarkable. She had a history of known, severe, life-threatening anaphylactic reactions to previous iodinated dye usage leading to respiratory arrest requiring intubation (despite adequate prophylaxis with steroids and antihistamines). Given her prior history of anaphylactic reaction to iodinated contrast, progressive escalation of medical therapy without repeat angiography was recommended. However, the patient continued to experience a progressive decline in quality of life despite maximal medical therapy. Therefore, coronary and bypass graft angiography was recommended. Coronary and bypass graft angiography was performed using 24 cc of undiluted Gadodiamide (OMNISCAN) with a power injector (ACIST®) without any incidents or premedication. The patient's coronary artery disease was essentially unchanged from her prior angiogram (Figure 1) and further intensification of anti-anginal therapy was recommended. Patient was monitored for 24 hours for arrhythmia and had repeat renal function in 24 hours and one-week post procedure, were within the normal limits.

## 3. Discussion

Coronary angiography with iodinated contrast is the gold standard for the diagnosis of coronary artery disease. However, the use of iodinated contrast may result in



**Figure 1.** Coronary angiography was performed using 24 cc of undiluted Gadodiamide with a power injector. The patient's coronary artery disease was essentially unchanged from her prior angiogram.

complications such as allergic reactions and renal function impairment. Allergic reactions from iodinated contrast are major complications and they have a wide spectrum which ranges from mild discomforts, such as nausea, vomiting, or itching to life-threatening emergencies, such as shock or cardiopulmonary arrest [1]. These reactions can also be either anaphylactoid reactions or chemotoxic reactions. The pathophysiology of the anaphylactoid reaction is attributed to the activation of the kinin system and the activation of the basophils and mast cells either directly by the contrast agent or indirectly by nonspecifically activated complements as anaphylatoxin (C3a, C5a). On the other side, a chemotoxic reaction could be caused by the hydrophobicity and hyperosmoticity of the contrast media [2].

The current modalities to evaluate patients' coronaries anatomy with typical angina symptoms include either cardiac catheterization or Coronary Computed Tomography Angiography (CCTA), which unfortunately use iodine contrast. In such scenario, we need an alternative imaging modality for evaluation. Gadolinium-based contrast media have been developed to improve the quality of magnetic resonance imaging (MRI) and are considered safer and less nephrotoxic than the iodinated agents. There are only a few studies about using gadolinium for coronary angiography have been reported.

We reviewed the literature about the use of gadolinium in patients with contrast allergy or renal failure and we found nine studies that included a total of 129 patients [1-9] [Table 1]. In 23 (17.8%) of these cases, the indications to use gadolinium were either history of severe allergic reaction or anaphylaxis to iodinated contrast [1,2,5]. In the rest of the cases, the indications were for renal failure or iodine-induced hyperthyroidism. In most of these cases, undiluted gadolinium was used. Two of these

studies reported the use of power injectors which showed improvement of image quality [2,5]. Diluted gadolinium did not yield better quality images compared to undiluted gadolinium, so we chose the undiluted one for our patient while using fluoroscopy as an imaging modality. It was also noted that a total of 5 cases (3.8%) developed ventricular arrhythmia (V tac vs V-fib) [2,5] and none of the studies reported death or deterioration of renal function as compared to baseline.

In a study by Kälisch et al. gadolinium was diluted 1:1 with sodium chloride (6-French) and identical contrast medium power injection (7 mL in the left coronary artery, 6 mL in the right coronary artery). This study revealed reduced picture contrast, but it was acceptable [2]. In another study, a 2 to 1 mixture of gadolinium and nonionic contrast was administered to improve the image quality without having to use the total required dose of contrast. Excellent quality angiograms were obtained while using only 1/3 of the quantity of contrast usually required [8].

Based on the previous studies, gadolinium is considered to be safer and less nephrotoxic than iodinated agents. It is best used for selective angiography in small-to medium-sized vessels [1]. However, the use of gadolinium is also associated with adverse reactions including potentially life-threatening cardiac arrhythmias after intracoronary gadolinium injection. Gadolinium also can cause acute renal insufficiency in high doses. Another disadvantage of gadolinium is the high cost, which is 5 times that of iodinated nonionic contrast agents. Also, the limited maximum recommended total carries a significant limitation [2].

In general, coronary angiography with gadolinium is feasible; however, certain technical consideration needs to be taken including dilution and injection rate while

**Table 1.** Literature review about the use of gadolinium in patients with contrast allergy or renal failure.

Author/Study	No of patients	Amount of contrast	Indication	Contrast used	Adverse reaction renal	Adverse reaction cardiac
1. Elizabeth Juneman,	1	24 ml	progressive angina and dyspnea on exertion + Severe allergic reaction	undiluted gadolinium	None	Ventricular arrhythmia
2. Kälsch	19	32.6 ± 10.9 ml power injection used	14 stable angina, 5 unstable angina + allergy/anaphylaxis/thyrototoxicosis with iodinated contrast media	Undiluted gadolinium	No deterioration in renal function (normal baseline)	Cardiac arrhythmias
3. Ose	3	40 ml	Recurrent chest pain, preoperative evaluation, graft patency evaluation p allergy/anaphylaxis with iodinated contrast media	Undiluted gadolinium	None	None
4. Reiger	29	0.23–0.44 mmol/kg body weight power injection used	Peripheral vascular disease, fistula and shunt disease, renal artery disease, aortic aneurysm + chronic renal insufficiency	Gd with (12) or without (10) carbon dioxide	No deterioration in renal function in all but one patient (abnormal baseline)	None
5. Sayin	26	57.1 ± 27.2 ml	Coronary angiography + chronic renal insufficiency	1 Gd: 1 nonionic low osmolar	No deterioration in renal function (abnormal baseline)	None
6. Sarkis	15	0.3 ± 0.1 mmol/kg gadolinium + 0.32 ± 0.2 ml/kg omnipaque	Coronary angiography + chronic renal insufficiency	2 Gd: 1 Nonionic low-osmolar iodinated (iohexol)	No deterioration in renal function (abnormal baseline)	None
7. Erley	10	0.34–0.9 mmol/kg body weight	Peripheral artery disease, renal artery disease, aortic aneurysm + chronic renal insufficiency	Gadobutrol (10 patients) iohexol (11 patients)	Similar reduction in GFR to iodinated contrast media	None
8. Brigouri	25	0.6 ± 0.3 mmol/kg body weight	Coronary angiography + chronic renal insufficiency	3 Gd: 1 nonionic low osmolar (iodixanol)	No reduction in CAN from to control (abnormal baseline)	None
9. Matuszczyk, A	1	30 ml	Myocardial infraction + iodine-induced hyperthyroidism	Gadolinium	None	None

Summary of Reported Cases and Case Series in Regards to Gadolinium Use in Patients with Contrast Allergy or Renal Failure.

using power injectors. As long as we can consider an appropriate mixture and injection rate, gadolinium can be an attractive alternative for patients who have contraindications of iodine contrast material.

#### 4. Conclusion

Gadolinium could be a reasonable option to be used in patients who have contraindications to iodine-based media because of severe allergy; it provides acceptable imaging quality, with some risk for ventricular arrhythmias when administered in recommended doses. The combination of using gadolinium with a power injector showed to improve the quality of images and reduce the amount of gadolinium administered.

#### Disclosure statement

No potential conflict of interest was reported by the authors.

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