

Elective Percutaneous Coronary Intervention Performed During Contrast-Induced Hypotension

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Abstract

Objectives: To demonstrate the feasibility and safety of performing percutaneous coronary intervention (PCI) during contrast reaction producing severe hypotension.

Background: The development of profound hypotension due to a contrast reaction usually signals procedure termination.

Methods and Results: We report successful completion of planned PCI with blood pressure support with vasopressors during contrast-induced hypotension in 9 procedures in 3 patients with previously known contrast reaction.

Conclusions: This case series provides support for the feasibility and safety of performing successful planned PCI under blood pressure support in patients with contrast reaction causing severe hypotension. A management approach for considering intervention in the setting of contrast-induced hypotension is provided.

Introduction

Severe hypotension is a rare complication of injecting iodinated contrast media during percutaneous coronary intervention (PCI). This reaction has been classically considered as “anaphylactoid” (as opposed to “anaphylactic”) as the bulk of current evidence suggests the reaction is not IgE-mediated although there are some data suggesting unknown antigens may provoke an IgE-mediated reaction (1,2). The primary event mediating hypotension appears to be activation of the mast cell producing profound peripheral arterial vasodilation. Intravenous epinephrine is usually effective in reversing hypotension until the effect of the endogenous arterial vasodilators passes. Most of the current medical literature has concentrated on the pathophysiological mechanisms and treatment of this disorder, and very little has been written on the ability to continue an interventional procedure during the reaction or planning an elective procedure in the setting of known severe contrast reaction.

We present 3 patients who underwent a total of 9 elective interventional procedures during an anaphylactoid hypotensive reaction (herein called “contrast reaction”). We present the results of the procedures and a suggested management approach in selected cases. As this was a retrospective case series, IRB approval was not required.

Patient 1

Patient was a 76 year old man with known coronary artery disease (CAD) and previously implanted left anterior descending (LAD) stent several years earlier referred for stable angina (CCS II). Patient had recently been admitted for heart failure during which time urinary retention developed requiring indwelling Foley catheter. Prostate surgery was deferred until the cardiac issue was resolved.

Catheterization performed via radial access showed instent LAD chronic total occlusion (CTO) with no significant lesions elsewhere (Figure 1a). PCI was unsuccessful using 6 Fr guide catheter with only partial guide wire passage and in-stent balloon dilation. It was felt that backup support was insufficient. Plan was to bring patient back for femoral access using 8 FR guide catheter and longer access sheath. The procedure used 248 ml of contrast (iodixanol) and was well tolerated.

The patient returned 6 weeks later. Initial non-invasive blood pressure was 154/83 mm Hg. Using micropuncture technique under ultrasound guidance, right femoral artery was accessed with angiography (iodixanol) showing sheath in the common femoral artery without evidence of extravascular contrast leakage. The first direct blood pressure measurement was **60/40 mm Hg** with heart rate of 40 bpm; the patient was asymptomatic. Patient immediately received 50 mcg intravenous (iv) phenylephrine and 1mg atropine. It was felt that patient was having a severe contrast reaction; 100 mcg of intravenous epinephrine, 125mg of IV methylprednisolone and 25 mg IV diphenhydramine were administered. Systolic pressure increased to approximately 170 mm Hg but gradually decreased to 80 mm Hg requiring additional 100 mcg epinephrine. The procedure was terminated. Patient was started on IV epinephrine drip (6 mg/min), observed for several hours with satisfactory blood pressure and discharged approximately 8 hours later.

The patient was brought back 4 months later. Patient had been premedicated with oral prednisone 60 mg x3 doses at 13, 7 and 1hour pre-procedure. The patient was given 25 mg oral diphenhydramine and 120 mg iv methylprednisolone immediately prior to first dye injection. Femoral access was obtained using micropuncture technique under ultrasound assistance with angiogram (iodixanol) confirming common femoral access without dye extravasation. An 8 Fr XB 3.5 guide catheter was passed to the ascending aorta where initial pressure was **64/37 mm Hg**. The patient remained asymptomatic. Based on knowledge of patient's contrast history, 500 mcg of epinephrine, 500 ml bolus of normal saline, and 125 mg iv methylprednisolone were immediately given. Blood pressure rose to 200/100 mm Hg. Although patient had had a previous hypotensive reaction to contrast, as he remained asymptomatic after rapid (<1 min) restoration of blood pressure, it was decided to proceed with PCI. Patient needed 100 mcg epinephrine twice during PCI when blood pressure decreased to 80/60 mm Hg. An epinephrine drip at 1 mg/min was started and titrated to a maximum of 8 mg/min. Patient remained stable and successful PCI of LAD CTO lesion was performed (Figure 1b). Following PCI, epinephrine drip was tapered over next 12 hours. The patient was discharged the following day.

Patient 2

Patient was an 81 year old man with history of hypertension, peripheral vascular disease, CAD with previous bypass surgery in 1995 and 1997 with sequential saphenous venous grafts (SVG) to LAD and first diagonal artery and first obtuse marginal (OM1) and posterior descending artery (PDA). Pre-operative angiograms prior to both bypass surgeries were well tolerated without contrast reaction.

Patient presented in 2014 with unstable angina. Baseline blood pressure was 145/80 mmHg. During first dye injection (iohexol) of the left coronary artery, patient became hypotensive (**40/20 mmHg**). He was immediately treated with iv saline bolus (500 ml), 1mg ephedrine, and dopamine infusion (10 mcg/kg/min). Blood pressure remained low at **60/40** mmHg. Subsequent angiography demonstrated 90% stenosis of SVG to diagonal artery/LAD with a filling defect and 90% stenosis of the SVG to OM1/PDA. Native vessels showed occluded right coronary artery (RCA), LAD and OM1 and patent circumflex (LCX). Due to persistent hypotension, patient received 1 mg iv epinephrine and started on phenylephrine 200 mcg/min and 40 units iv vasopressin. Hypotension was complicated by episodes of ventricular tachycardia. Intra-aortic balloon pump (IABP) was placed. It was felt that hypotension was secondary to ischemia. PCI to the SVG to diagonal/LAD with 3.5x38 mm and 3.5x23 mm bare metal stents was performed followed by bare metal stenting of SVG to OM1/PDA. Post-procedure, patient hemodynamically improved. IABP and pressors were gradually weaned over the next 24 hours.

In 2015 patient developed worsening angina. Immediately after the first contrast injection (iohexol), patient developed profound hypotension (**40/20 mmHg**). Hemodynamic collapse was attributed to contrast reaction. He was treated with iv saline bolus (500 ml), methylprednisolone 250 mg, famotidine 20 mg, and diphenhydramine 50 mg. IV phenylephrine 200 mcg/min and dopamine 10 mcg/kg/min were immediately started. Repeated iv doses of 100-200 mcg of epinephrine were given to maintain systolic blood pressure above 90 mmHg. Angiography demonstrated a 90% stenosis of SVG to OM1/PDA and 70% stenosis of the proximal CX. SVG graft was stented with 2.5x33 mm Promus drug-eluting stent and LCX lesion with 3x24 mm Promus stent. IABP was placed and rapidly weaned post-procedure.

In 2017 patient developed unstable angina. Patient had been premedicated with iv methylprednisolone 125 mg, oral diphenhydramine 50 mg and famotidine 20mg at 24, 12 and one hour prior to the procedure. First angiogram (iohexol) showed occluded RCA. Within a minute the patient developed hypotension (**60/40 mmHg**). It was felt that despite pre-medication, patient had developed a contrast reaction. He was treated with iv epinephrine 1mg and vasopressin 40 units. There was minimal hemodynamic response. Dopamine 20 mcg/kg/min and phenylephrine 200 mcg/min infusion were then started.

Despite these measures, the patient developed asystole. Cardiopulmonary resuscitation was started with restoration of spontaneous circulation. IABP was initially placed and subsequently upgraded to left ventricular support with Impella. Hemodynamics improved. Angiography demonstrated a 70% in-stent restenosis in the SVG to OM1/PDA. The in-stent restenosis was treated using 4.0 x20mm Promus stent. Over the next 48 hours the patient remained completely dependent on maximal inotropic support as well as Impella CP. Since there were no signs of recovery, the family decided to withdraw care and the patient expired.

Patient 3

Patient was a 61 year old man with past history of hypertension, peripheral artery disease, and CAD with previous bypass surgery in 2009 (LIMA to LAD, SVG to RCA, SVG to OM). Prior to bypass surgery, the

patient had undergone four separate angiograms and PCIs without contrast reaction.

In 2008 patient was scheduled for elective PCI of a LCX CTO and RCA. During PCI the patient developed severe hypotension (systolic pressure **40 mm Hg**) which was initially attributed to 200 mcg IC nitroglycerin which had been given a few minutes earlier. However, the patient remained hypotensive. Blood pressure improved after 1 mg iv epinephrine. The procedure was continued with a 3.5x20 Taxus stent deployed in the proximal RCA with unsuccessful attempt at opening LCX CTO. Blood pressure was stable throughout the procedure after a single epinephrine dose.

Patient returned 8 month later with unstable angina. Angiography (iohexol) of left system was performed without decrease in blood pressure. During RCA injection blood pressure precipitously fell (**40/20 mm Hg**). He was treated with 1 mg iv epinephrine which increased blood pressure to 200/100 mmHg which gradually decreased to 90 mmHg systolic. He was started on dopamine 10 mcg/kg/min infusion, which was weaned quickly. The case was terminated with this event classified as a contrast reaction.

One year later patient developed severe unstable angina and was taken urgently for angiography without pre-medication. Upon initial contrast injection (iohexol) the patient developed severe hypotension. He was then treated with ephedrine 1mg, diphenhydramine 50 mg and methylprednisolone 250 mg iv. Blood pressure improved to 80/60 mmHg. The procedure was terminated. Subsequently, he had successful bypass surgery.

The patient presented with unstable angina in 2013. Urgent angiography (iohexol) was performed without premedication. There was severe stenosis of the LAD distal to the patent LIMA graft. SVG to PDA had 70% stenosis. The distal LAD was stented with a 2.5x16 mm Promus stent and the proximal LAD with a 3x12 Veriflex stent. Despite no pre-medication and previous presumed contrast reaction, the procedure was performed uneventfully using 75 ml of contrast.

In 2014 patient again presented with unstable angina. With the initial iohexol injection, systolic blood pressure decreased to **60 mm Hg**. He was treated with intravenous saline, methylprednisolone 125 mg, phenylephrine 200 mcg/min and 40 units vasopressin. Repeated doses of 100 -200 mcg epinephrine were administered every 3-4 minutes to maintain mean arterial pressure >70 mmHg. Further angiography showed a new 99% stenosis in a large OM branch which underwent drug-eluting stenting (2.5x12mm Xience stent). Phenylephrine and vasopressor drips were gradually weaned by the end of the procedure.

Progressive angina recurred in 2016. Patient was premedicated for three days prior to the angiography using methylprednisolone 125 mg iv every 12 hours, diphenhydramine 50 mg orally twice a day, and famotidine 20 mg orally daily. PCI was performed without profound hypotension. However, there was a decrease in systolic blood pressure from 160 to 90 mmHg after first injection of iohexol.

The patient developed a non-ST segment elevation myocardial infarction (NSTEMI) in 2017. Premedication was the same as in 2016. Within the first few minutes of angiography (iohexol),

significant hypotension ensued. The hypotensive reaction was anticipated. Epinephrine (100 mcg) was immediately administered via central line, normalizing blood pressure. Angiogram demonstrated 90% OM2 stenosis and 99% LAD stenosis distal to the previously placed stent. Stenting of OM2 (2.5x38 mm Promus stent) and balloon angioplasty of LAD were performed. PCI was completed safely, administering 100-200 mcg of epinephrine as need to maintain normotension.

The last two episodes of unstable angina in 2018 were treated utilizing similar strategy, three days of premedication as described above. Hypotension (**60/40 mmHg**) occurred within 2-3 min following first injection of iohexol in both cases. PCI of culprit lesion was successfully treated in each case using 100 – 200 mcg of epinephrine iv boluses every 3-4 min with maintenance of blood pressure.

Discussion

Profound hypotension from contrast media during a vascular intervention is a rare but potentially fatal event. Its immediate treatment can restore normal blood pressure. Typically, at this point the procedure is terminated to allow the patient to fully recover. Previous literature has concentrated on the prevention of and proper treatment of this complication (1,2).

The primary message of the current report is that in some cases coronary intervention can still be performed during a contrast reaction. In fact, in patients with a known contrast reaction, one can plan to perform an elective intervention as seen in these three patients who underwent a total of 9 successful PCI procedures while being hemodynamically supported during a contrast reaction. This report is the first to describe planned interventions in the setting of a previously known contrast reaction causing hypotension with successful PCI despite recurrent hypotension requiring pharmacological support. A previous report suggested the possibility of performing intervention during interventional procedures but profound hypotension was not described in any of the 11 reported patients (3).

That PCI can be performed as in the described cases does not imply it should always, or even frequently, be performed. However, under appropriate circumstances it may be considered. We suggest that the most important factors relate to the time required to adequately treat the hypotension, the patient's co-morbidities, patient's comfort level, and the criticality of performing the coronary intervention (Figure 2). If the patient's hypotension can be reversed quickly, i.e. within a minute, and the blood pressure can be maintained with reasonable pressor support, it is suggested that the risk of end organ dysfunction, e.g. acute renal failure, should be low. In that circumstance, if it is felt that PCI is the most appropriate treatment and the patient is comfortable, consideration of continuing the procedure seems reasonable. If, on the other hand, developing hemodynamic stability requires a prolonged period, e.g. greater than 10 min, or blood pressure cannot be maintained adequately with pressor then terminating the procedure and following for end-organ dysfunction seems most reasonable. In cases with intermediate times to hemodynamic stability, e.g. 2-9 minutes, then decision-making should be individualized based on patient's co-morbidities, hemodynamic stability, ability to maintain adequate blood pressure with

pressors, the clinical syndrome, and coronary anatomy dictating the urgency of treatment. The multiple PCIs in the 3 patients essentially satisfied these criteria.

Although pre-treatment with steroids and antihistamines in patients with previous contrast reactions is recommended by current ACC AHA guidelines, evidence that these medications can prevent repeat severe reaction is scanty (1,2,4). The present cases highlight that pre-treatment is not necessarily protective. Although these agents may be used, the operator must be aware that they may be ineffective and be vigilant to rapid treatment for a repeat contrast reaction.

The present case series also emphasizes the vagaries of a severe contrast reaction. In these 3 cases, once the patient had developed a contrast reaction, it occurred in most cases. However, in one of the procedures in Patient 3, PCI was performed without a reaction despite no pre-medication. It is also interesting that in the 3 patients, all had initial angiography without reaction, suggesting the possibility that initial exposure created an undetermined IgE antibody producing the subsequent reaction (1).

Conclusion

This case series demonstrates that elective PCI can be performed during a severe contrast reaction producing hypotension. It is recommended that if certain conditions are fulfilled, PCI may be considered despite an ongoing anaphylactoid reaction. These conditions include 1) rapid treatment initially preventing prolonged hypotension and subsequent risk of organ damage, 2) blood pressure easily modulated by iv epinephrine 3) the patient being comfortable and asymptomatic during the contrast reaction and 4) that PCI is the most appropriate therapeutic option.

Declarations

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Conflicts of interest/Competing interests: There are no relationships with industry or other conflicts of interest for any of the authors.

Availability of data and material (data transparency): The data are available from the corresponding author on request within the confines of all relevant regulations regarding patient privacy.

Code availability (software application or custom code): none

Authors' contributions: All the authors have provided input into the conceptualization of the study and have contributing to its preparation.

Additional declarations: None

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Consent to participate: Not applicable

Consent for publication: All authors have approved the contents of the manuscript and consent for publication.

References

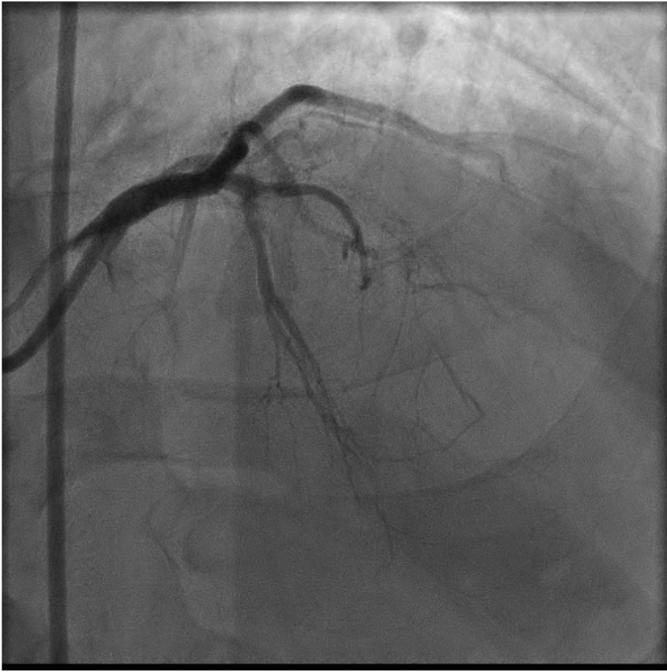
1. Ingelmo RA, Doña Diaz I, Cabañas Moreno R, Moya Quesada MC, García-Avilés C, García Nuñez I, Martínez Tadeo J, Mielgo Ballesteros R, Ortega-Rodríguez N, Padial Vilchez MA, Sánchez-Morillas L, Vila Albelda C, Moreno Rodilla E, Torres Jaén MJ. Clinical practice guidelines for diagnosis and management of hypersensitivity reactions to contrast media. *J Investig Allergol Clin Immunol* 2016; Vol. 26(3): 144-155 doi: 10.18176/jiaci.0058.
2. Schrijvers R, Demoly P, Chiriac AM. Premedication for iodinated contrast media induced immediate hypersensitivity reactions. *Curr Treat Options Allergy* (2019) 6:538–553. DOI 10.1007/s40521-019-00224-z
3. Aykan AC, Duygun, Aykan AD, Katırcıbaşı MT, Özgül S. Management of radio-contrast allergy in radio-contrast allergic patients undergoing coronary angiography and intervention. *Kardiologija* 2020;60(10):62-65. doi: 10.18087/cardio.2020.10.n1117
4. Levine G, Bates ER, Blankenship JC, Bailey SR, Bittl JA, Cercek B, Chambers CE, Ellis SG, Guyton RA, Hollenberg SM, Khot UN, Lange RA, Mauri L, Mehran R, Moussa ID, MD, Mukherjee D, Nallamothu BK, Ting HH. 2011 ACCF/AHA/SCAI Guideline for Percutaneous Coronary Intervention. *JACC* 2011; 58:e44-e122.

Tables

Due to technical limitations, tables are only available as a download in the Supplemental Files section.

Figures

A)



B)

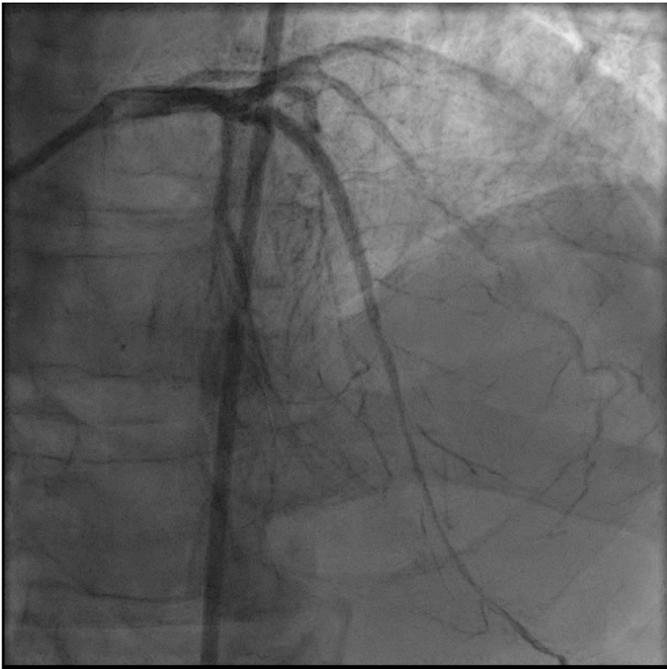


Figure 1

Elective PCI was performed in Patient 1 during contrast reaction requiring pharmacological support of blood pressure. Figure 1a shows LAD CTO at baseline and Figure 1b shows final result with patent LAD.

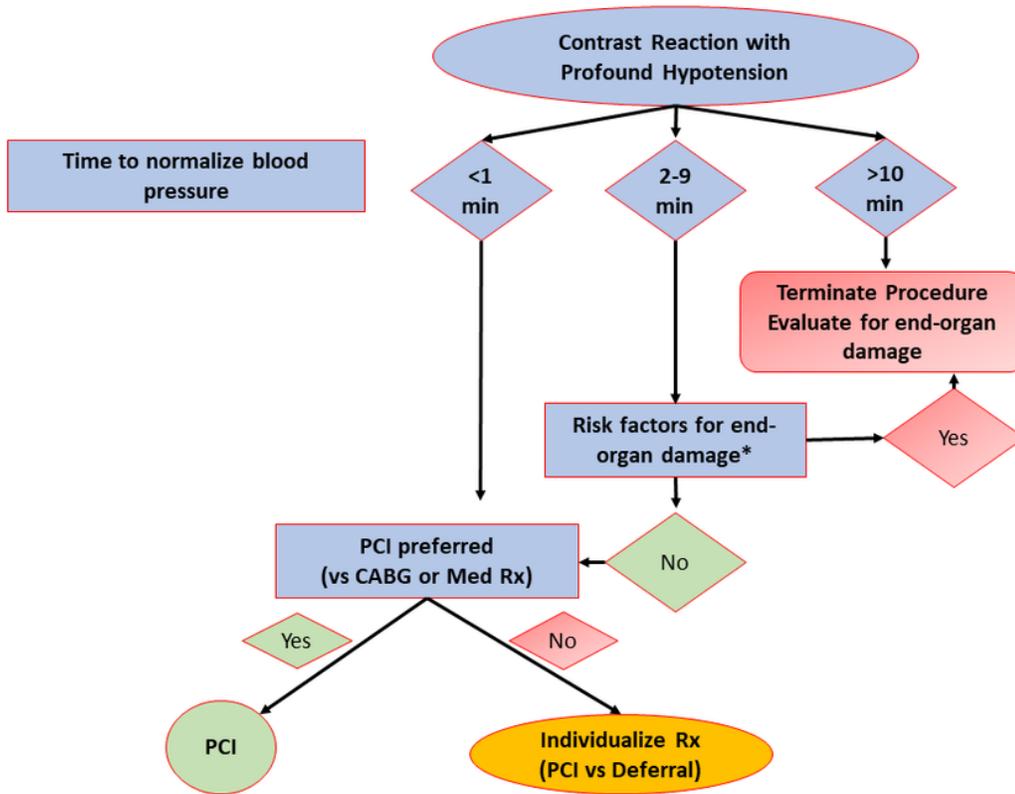


Figure 2

The figure provides a proposed management approach to deal with contrast-induced hypotension during PCI. The algorithm should be considered a general framework and the times proposed as guidelines in view of lack of information in the medical literature. *Risk factors for end-organ damage may include previous stroke, severe LV dysfunction, heart failure, severe CAD, chronic kidney disease. CABG=coronary artery bypass surgery; Med =medical; Rx=treatment

Supplementary Files

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- [AnaphylacticTable1FINAL.docx](#)