

## Percutaneous Management of Iatrogenic Radial Perforation with Stent-Grafting

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### Abstract

Radial access is becoming an increasingly successful alternative to femoral access for invasive coronary procedures, given its overall greater safety despite the need for a learning curve. Indeed, rates of local access site complications are universally lower with transradial than transfemoral approach. Despite their rarity, radial complications such as dissection, pseudoaneurysm, and arteriovenous fistula still occur, and may lead to dire consequences, including hand ischemia or compartmental syndrome. We hereby report a case of iatrogenic perforation of the right radial artery occurring during percutaneous coronary intervention, which was successfully treated during the same procedure with stent-graft implantation. This management approach should be borne in mind as a safe treatment of radial perforation, to minimize the risk of pseudoaneurysm, arteriovenous fistula or compartmental syndrome, together with other alternative approaches including external compression, balloon occlusion, or embolization.

### Keywords

angiography; complication; coronary artery disease; covered stent; perforation; radial access; radial artery; stent-graft

### Introduction

Since the late 80's, when it was first reported, transradial approach to coronary catheterization and intervention has progressively become the main alternative to transfemoral access [1,2]. Accounting for more than 10% of all procedures performed worldwide, radial access offers indeed many advantages, the main one being significantly lower rates of clinically relevant vascular complications (e.g. local bleeding, pseudoaneurysm, arteriovenous fistula, or retroperitoneal hemorrhage), better feasibility in certain subset of patients (e.g. obese, those with iliofemoral disease or under oral anticoagulant therapy), and earlier ambulation with consequent shorter hospital stay [2,3]. On the other hand, certain characteristics may limit the use of the radial access in everyday practice.

Actually, the radial approach implies a new learning curve for transfemorally competent operators (with increased procedural time and radiation exposure), the risk of artery spasm or other technical difficulties typically occurring when specific anatomic variants are present (e.g. bovine aortic

arch), potentially requiring conversion to transfemoral approach [4]. Despite their rarity, local access site complications occur also with transradial access, and may be more challenging to treat given the small size of this vessel, limiting the approach with large diameter sheaths and catheters, as well as the risk of compartmental syndrome or hand ischemia.

In the present case report, we originally describe a case of iatrogenic radial artery perforation occurring during cardiac catheterization, promptly and successfully managed with stent-graft implantation.

## Case Presentation

A 49-year-old gentleman was admitted for objective evidence of silent myocardial ischemia 14 months after percutaneous coronary intervention (PCI). He had hypertension, dyslipidemia and a history of prior smoking. More than a year before, because of a non-ST-elevation acute coronary syndrome, three vessel disease had been discovered at coronary angiography, involving the left anterior descending (LAD) artery, the right coronary artery (RCA) and the first obtuse marginal branch (OM1), with accompanying mild reduction in left ventricular systolic function (ejection fraction 48%). The patient was offered surgical revascularization, but, given his refusal, a percutaneous approach was preferred. Percutaneous coronary intervention with multiple drug-eluting stents was performed on the LAD and a follow-up single photon emission computed tomography (SPECT) was recommended [5]. The exam, performed a year later, showed persistent residual inducible ischemia in the infero-apical region.

The patient was thus readmitted for coronary angiography and possible PCI. After successful angiography of the RCA (which appeared free of disease progression) and evidence of restenosis in the LAD, PCI was attempted on the LAD. However, due to difficulties in selectively engaging the left coronary ostium, several guiding catheters were exchanged, but during such exchanges an XB 3.5 6 French guiding catheter (Cordis, Miami, FL, USA) irreversibly kinked during retrieval in the right radial artery while it was pulled forcefully back. The patient experienced sudden excruciating pain the right forearm, with evident contrast extravasation due to radial artery perforation at control angiography (Figure 1).

Despite several attempts, the rupture could not be sealed by prolonged external compression, either manually or with a brachial cuff, and thus a decision was made to quickly rewire in a retrograde fashion through the same right radial artery the perforated vessel with a 0.014" guidewire (Choice PT, Boston Scientific, Natick, MA), and seal the perforation with a covered stent-graft (Graftmaster 3.0x15 mm, Abbott Vascular, Santa Clara, CA, USA) expanded at 18 atmospheres, achieving adequate stent expansion. Notably, no guiding catheter was used as the radial sheath ensured adequate image quality. The final angiographic control showed a satisfactory result without any residual contrast leakage and complete sealing of the perforation. Despite successful arterial repair, blood loss was remarkable (hemoglobin nadir 7 g/dL). The patient thus underwent repeat blood transfusions until restoration of normal hemoglobin levels (13.8 g/dL) could be obtained. Anticoagulation reversal was not performed given the potential risk of vascular thrombosis, whereas a longer sheath was not used because not available at the time in our catheterization laboratory. At discharge the patient's arm was moderately edematous, without radial pulse, but motricity and sensitivity were preserved, thus excluding any compartmental syndrome.

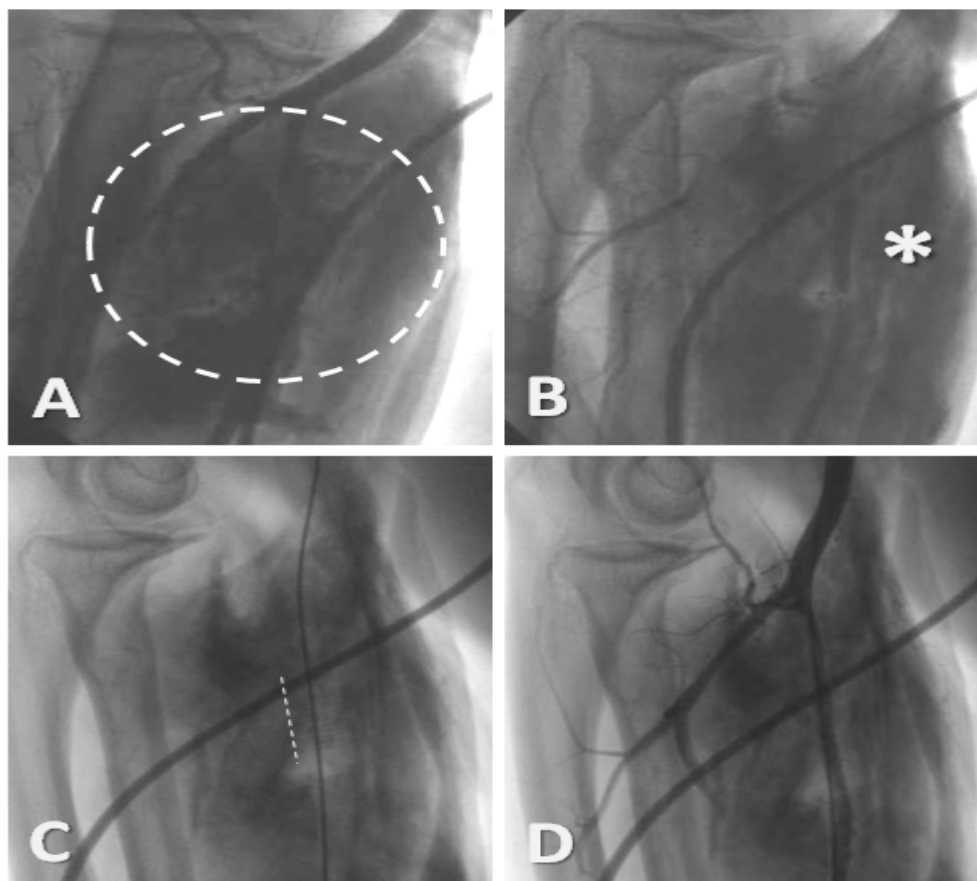
Three months later, PCI was attempted again and successfully achieved by the transfemoral route in the LAD, RCA and OM1. Physical examination during this new admission showed persistent lack of palpable right radial pulse, implying most likely the persistent occlusion of the radial artery, with otherwise normal motor and sensor function of the right hand.

## Discussion

According to the scholarly literature, the main advantage of transradial approach compared with transfemoral route is the reduction of major bleeding complications [6,7]. However, severe complications, such as vessel occlusion, leading to acute ischemia or perforation leading to compartmental syndrome, can occur rarely in the radial artery as a result of catheter injury. Previous small case series documented the management of radial perforation by means of external manual compression, inflation of a coronary balloon across the perforated segment, combined external compression with internal occlusion, anticoagulation reversal, coil embolization, or temporary exclusion of the perforation site with deployment of a slightly oversized and longer sheath [8]. In the present report, since manual compression was unsuccessful, a covered stent was required to repair radial rupture and to stop blood extravasation.

This clinical vignette emphasizes the need for careful handling of catheters in the delicate radial and brachial vessels, as well as the importance of maintaining access to the arterial vessel in order to enable, when appropriate, timely treatment of radial perforation by means of stent-grafting. It also supports considering stent-grafting as an alternative management means to quickly and effectively treat iatrogenic radial perforation.

## Figures



**Figure 1:** Iatrogenic radial perforation during attempted percutaneous coronary intervention in a 49-year-old man with silent myocardial ischemia. Due to difficulties in engaging the coronary ostia, several guiding catheters were exchanged, but during such exchanges an XB 3.5 6 French guiding catheter (Cordis, Miami, FL, USA) kinked and damaged during retrieval the right radial artery. The patient experienced sudden excruciating pain the right forearm, with evident contrast extravasation due to radial artery rupture (panel A). Despite several attempts, the rupture could not be sealed by external compression, and thus a decision was made to quickly rewire the radial and brachial artery retrogradely with a 0.014" guidewire (Choice PT, Boston Scientific, Natick, MA, USA), and seal the perforation with a stent-graft (Graftmaster 3.0x15 mm, Abbott Vascular, Santa Clara, CA, USA) expanded at 18 atmospheres (panel B), achieving adequate stent expansion (panel C). The final angiographic control showed a satisfactory final resulting without any residual contrast leakage and complete sealing of the perforation (panel D).

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