Radial Artery Perforation and Its Management during PCI

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ABSTRACT: Radial artery perforation is a rare but important complication of the transradial approach. This report highlights two cases of radial artery perforation during percutaneous coronary intervention managed by simple strategies without resorting to an alternative route. The guiding catheter itself helps to seal the perforation, hence continuing to perform the procedure through the same route is an effective way to seal off the perforation.

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The transradial route is an elegant and reliable means of access to coronary arteries and performing percutaneous intervention (PCI). The major advantages of the transradial route are the lower access site complications and improved patient comfort in addition to reduced costs. Vascular site complications with the use of the radial route are virtually absent. Hence, it is emerging as the access route of choice, especially in primary PCI, where the use of glycoprotein IIb-IIIa inhibitors is more frequent. We present two cases of iatrogenic radial artery perforation that were managed using simple interventional techniques.

Case Report 1. *A 70-year-old female presented to our emergency department with acute inferior myocardial infraction (MI) of 3 hours' duration with ongoing chest pain. On examination, she had sinus tachycardia (heart rate 114 beats per minute), hypotension (systolic blood pressure 60 mmHg), with a LVS4 gallop and bilateral basal rales.*

Primary PCI was scheduled. As per our institute's protocol, a loading dose of 325 mg aspirin and 600 mg clopidogrel was given orally before the procedure. The right radial artery was chosen, as we routinely perform all primary PCIs through the radial approach. An Allen's test on the right hand was normal and the right radial artery was punctured, a 6 Fr sheath was inserted and 10,000 units of heparin were given intra-arterially. The immediate next step was to insert a guidewire through the radial artery. There was resistance to crossing with a 0.035 inch Teflon-coated guidewire. A radial artery angiogram was performed and revealed a radial artery perforation with contrast extravasation due to a larger-sized radial sheath within a small radial artery (Figure 1A).

At this juncture, the operator must decide whether to cross over either to the opposite radial artery or to the femoral approach, but we decided to continue performing the PCI through the right radial artery. We thought that this might help seal the perforation, though we anticipated difficulty in crossing the perforated area through the true lumen of the radial artery. We used a 0.021 inch hydrophilic guidewire (Terumo Medical Corp., Somerset, New Jersey) and meticulously crossed the site of perforation under fluoroscopic guidance. Then, with difficulty (due to radial artery spasm), the diagnostic catheter was passed.

Coronary angiography revealed normal left main and Left anterior descending coronary arteries with 70% stenosis of first obtuse marginal coronary artery. Exchange of the catheter to a Judkins right coronary guiding catheter could not be performed easily with a normal 0.035 inch guidewire because of the severe radial artery spasm induced by the perforated radial artery. The catheter was then exchanged using a 0.035 inch Amplatz extra-stiff guidewire (Boston Scientific Corp., Natick, Massachusetts) and a three-dimensional right coronary artery (RCA) guiding catheter (Cordis Corp., Miami Lakes, Florida) was used, providing excellent backup support.

Angiography showed 100% occlusion of the RCA. The total occlusion of RCA was crossed with a 0.014 inch BMW guidewire (Guidant Corp., Indianapolis, Indiana) and parked in the distal RCA. The RCA had huge amounts of thrombus with distal thrombolysis in myocardial infarction (TIMI) 1 flow. In view of the large thrombus burden, we considered administering GP IIb-IIIa Inhibitors, but elected not to because of the radial artery perforation. The occluded segment was directly stented with a 3 x 23 mm Zeta stent (Guidant) at 12 atm to reduce the distal embolization. Post stenting, there was a 70% stenosis in the mid-RCA distal to the stent. Another 3 x 18 mm Zeta stent was deployed at 10 atm overlapping the proximal stent and achieving a good result. After a few minutes, patient developed acute in-stent thrombosis associated with increased ST elevation. In view of this, despite the radial perforation, an abciximab bolus was administered and the in-stent thrombosis was treated by postdilatation of the stent with 3.5 x 20 mm balloon (Guidant) at 10 atm for 20 seconds. Final angiography revealed TIMI 3 flow, with no thrombus, dissection or residual stenosis. The patient's hemodynamics improved and there was ST-segment resolution. At the end of the procedure, a radial artery angiogram was done, showing a sealed perforation with good flow in the radial artery. The procedure required 63 minutes from the time of local anesthesia to completion of the procedure.

Case Report 2. *This patient presented with acute anterior wall MI and primary angioplasty to the left anterior descending artery was performed through right transradial approach after administrating a loading dose of 325 mg aspirin and 600 mg* *clopidogrel. The patient developed radial artery perforation (Figure 2A). We adopted the same technique as in Case 1 and were able to successfully complete the procedure via the radial approach. At the end of the procedure, re-check angiography showed a completely sealed radial perforation (Figure 2B). A total of 57 minutes elapsed from the time of local anesthesia to completion of the procedure.*

We would like to highlight the following technical tips to handle radial perforation:

1. Radial perforation can be caused by a mismatched radial sheath size or guiding catheter or sometimes by hydrophilic wires.
2. In most cases, it is not necessary to switch to an alternate access site.
3. Extreme care must be taken in crossing the perforation site using a hydrophilic guidewire.
4. The radial perforation can be sealed off with the guiding catheter.
5. GP IIb-IIIa blockers can be cautiously used, even in the presence of radial perforation, provided that the procedure is carried out via the same access site.

Discussion. Interventional cardiologists prefer the transradial approach to the transfemoral approach because of the reduced vascular complications and improved patient comfort the former approach provides. The number of transradial procedures has been increasing steadily worldwide. The primary advantages of the transradial approach are the virtually nil local vascular complications,[1] early mobilization, same-day discharge and reduced cost to the patient.[2] Moreover, despite the use of several anticoagulant agents, the radial sheath can be removed immediately after the intervention.

The noteworthy complications with the transradial approach are asymptomatic radial artery occlusion (3–5%), radial artery perforation, local hematoma and, in rare incidences, hand ischemia. Radial artery perforation is a rare and significant complication of the transradial procedure. It occurs in about 1% of all transradial procedures.[3] Radial artery perforation is more likely to occur in patients with small radial arteries, in the elderly with tortuous radial arteries, in hypertensive patients, in radial artery loops and, more importantly, in cases of inadvertent forceful manipulation of the guidewire and catheters. The dictums of the radial procedure are to never force a guidewire or catheter and to have a low threshold for radial angiography to identify anatomical abnormalities. Due to the dual blood supply to the hand, the incidence of hand ischemia is very rare following radial artery perforation, but this is a common reason for switching from the transradial to the transfemoral approach. Moreover, it reduces operator's confidence in the radial artery approach.

Procedure times in the cases presented here were 63 and 57 minutes, respectively, from the time of local anesthesia to completion of the procedure including diagnostic angiography followed by intervention, which were not unduly prolonged compared to what was reported by Orazio Valsecchi et al, where the mean total procedure time (from patient arrival to the catheterization laboratory to completion of the procedure) using the radial approach in elective PCI was 62 ± 23 minutes.[4]

Cannulation time (from the time of administration of local anesthesia to the time of arterial cannulation) and total procedure time did not significantly differ between the transradial approach and the transfemoral approach.[4] Provided it is performed by experienced operators, the transradial approach can represent a safe and feasible method for performing primary angioplasty with similar results to those of the transfemoral approach, and there is no prolongation of procedure time in transradial primary angioplasty.[4–6]

The balloon-to-artery ratio may be more important than stent inflation pressure and correlates significantly with relative stent expansion in an IVUS study.[7] The stent chosen in Case 1 was 3 mm diameter (balloon-to-artery ratio 1:1) and was directly deployed only at 10 atm. Microembolization may play a deleterious role in acute MI[8,9] and direct stenting could prevent embolization and no-reflow.[10] The impact of inflation pressure on the incidence of slow/no flow is another issue. It has also been postulated that distal embolization may occur more frequently after high-pressure deployment in acute MI. Even though the stent was sized to the vessel, the low-pressure deployment could have contributed to acute stent thrombosis in Case 1, but after stent thrombosis, the stent was postdilated using a larger 3.5 mm balloon.
Santos et al[3] suggested an approach whereby the operator can complete the procedure through the same radial approach and also treat the perforation. After administration of a spasmolytic cocktail, they crossed the perforated radial artery with a 0.021 inch hydrophilic guidewire over which they inserted a long arterial sheath until the tip was lodged in the brachial artery.

After completing the procedure check, angiography showed closure of the radial perforation. Of note, they were able to do this in all 9 cases of perforations without any major complications.
In this report, we have described two cases of radial artery perforation in which the guiding catheter used to complete the procedure also helped seal the perforation. An alternate way of approaching this problem is to use a long sheath, as reported previously.[3] Using the guiding catheter is an elegant alternate means of dealing with radial artery perforation compared to use of a long sheath, as we believe that a long sheath is difficult in the presence of tortuosities and can predispose the patient to radial artery spasm. In the first case, because of intraprocedural stent thrombosis, we were forced to use abciximab and were able to remove the sheath and achieve good hemostasis despite the perforation.

Conclusion. We conclude that radial artery perforation is a rare but important complication of the transradial approach. This report highlights that radial artery perforation during transradial procedures is eminently manageable by simple strategies, may not require a switching to the femoral approach or the opposite radial route, and continuing to perform the procedure through the same access may in fact be an effective way to seal off the perforation.

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