



## Recurrent Arteriovenous Fistula as a Rare Complication of Coronary Angiography by Transradial Approach: A Case Report

Sheharyar Minhas<sup>1</sup>, Kevin Barretto<sup>2</sup> and Sunil Dhar<sup>1</sup>

<sup>1</sup>Department of Cardiology; Department of Internal Medicine, Nazareth Hospital, Philadelphia, PA, USA

<sup>2</sup>Philadelphia College of Osteopathic Medicine, Philadelphia, PA, USA

\*Corresponding author: Sheharyar Minhas, Department of Cardiology; Department of Internal Medicine, Nazareth Hospital, Philadelphia, PA, USA, Tel: 001-2153356000; E-mail: [sminhas7@yahoo.com](mailto:sminhas7@yahoo.com)

Received date: November 10, 2018; Accepted date: November 21, 2018; Published date: November 27, 2018

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### Abstract

**Introduction:** Coronary catheterization via a right radial approach has been associated with a decrease in access site complications, such as hematoma, pseudoaneurysm, arteriovenous fistula (AVF), arterial dissection, arterial perforation, and neurological deficits. Iatrogenic AVF is a rare vascular complication which may result from coronary angiography. Previous case studies have reported resolution of AVF following transradial catheterization with conservative treatment rather than a surgical intervention. We report a case of AVF as a complication of transradial coronary angiography that reoccurred after an initial resolution following a conservative management, requiring further treatment with a surgical embolization.

**Case:** A 58-year-old male was admitted for retrosternal chest pain. Initial troponins and EKG was normal. Despite antianginal medications, he continued to have chest pain. He underwent percutaneous coronary angiography via right radial approach. Findings were significant for non-obstructive lesion of left anterior descending artery and moderate restenosis of previously placed stent. Three days later he complained of wrist discomfort and warmth over right radial catheterization access site. Doppler ultrasound showed a fistulous between radial artery and vein. Pressure device was used for conservative management and repeat imaging the next day demonstrated fistula resolution. Three months later, patient returned to hospital with similar presentation and was diagnosed with chronic chest pain syndrome. During this time, he complained of reoccurrence of right wrist discomfort. Ultrasound confirmed presence of AV fistula formation, which was treated with surgical embolization. Patient tolerated the surgery well with resolution of the AV fistula and associated symptoms.

**Discussion:** This case highlights AV fistula is a rare complication of transradial catheterization. While there is no consensus regarding management, previous case reports have recommended conservative management. However, reoccurrence of AVF in this patient may indicate a need for increased follow up and surveillance in order to ensure true resolution of this rare complication.

**Keywords:** Arteriovenous fistula; Transradial approach; Coronary angiography; Transfemoral approach; Embolization; Iatrogenic; Catheterization

### Introduction

Coronary catheterization using a radial access site as opposed to a femoral access site has been associated with many benefits, such as reduced cost, decreased mortality, and fewer complications in establishing arterial access [1-3]. Access site vascular complications, including groin hematoma, pseudoaneurysms, arteriovenous fistula (AVF), arterial dissection, arterial perforation, and neurological deficits have all been shown to be significantly reduced via transradial approach compared to the transfemoral approach [4-6]. Major bleeding following coronary artery catheterization remains an independent predictor of mortality [4]. Recent studies have yielded promising results demonstrating a reduction in bleeding risk when comparing a transradial approach to a transfemoral approach. The RIFLE-STEACS trial found a 47% reduction in the rate of access site related bleeding complications as well as an overall decrease in cardiac death [2]. The transradial approach has also gained favor with patients

as it is associated with increased comfort and a decreased time to ambulation following the procedure. Iatrogenic AVF is a rare vascular complication, which may result from coronary angiography. The incidence of AVF formation following a transfemoral approach has been well documented. However there are far fewer publications that discuss AVF formation following a transradial approach [7,8]. Furthermore, there is no general consensus regarding the management and treatment of AVF formation when radial access is utilized. Previous case studies have reported resolution of AVF following transradial catheterization with conservative treatment rather than a surgical intervention [4]. Here, we report a case of AVF as a complication of transradial coronary angiography that reoccurred after an initial resolution following a conservative management, requiring further treatment with a surgical embolization.

### Case Report

A 58-year old Caucasian male with cardiac risk factors including hypertension, stable angina, myocardial infarction, coronary artery disease, peripheral vascular disease, diastolic congestive heart failure, insulin dependent diabetes mellitus, hyperlipidemia, and a 20-pack

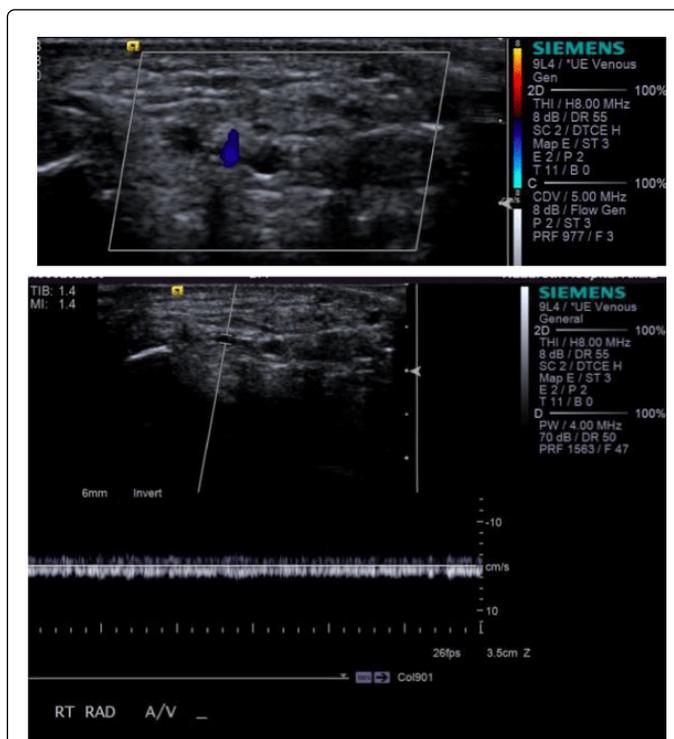
year smoking history presented to the emergency department with chest pain for one day. He described his chest pain as burning retrosternal sensation radiating to his left jaw associated with diaphoresis, nausea, and vomiting. He underwent cardiac catheterization three years prior with placement of a drug-eluting stent in the left anterior descending artery. Subsequent cardiac catheterization the same year showed a patent left anterior descending artery stent. Previous echocardiogram indicated left ventricular diastolic dysfunction with an ejection fraction of 55-60%. Recent stress test showed anteroseptal scarring with no ischemia. Patient was compliant with his medications, including aspirin 81 mg daily, plavix 75 mg daily, atenolol 50 mg daily, diltiazem 120 mg daily, and losartan 25 mg daily. He was previously prescribed ranexa 500 mg twice daily but he was non-adherent. Initial serial troponins were negative. EKG showed sinus rhythm at 98 bpm, left axis deviation, and nonspecific ST-T wave changes. Patient's medications were optimized to include imdur 60 mg daily and atenolol was changed to lopressor 75 mg twice daily. Despite optimization of his antianginal treatment, the patient continued to complain of persistent chest.

Plan was subsequently made for coronary angiography to rule out obstructive coronary artery disease. After confirming dual arterial supply of the palmar arch with a negative Allen's test, coronary angiography was carried out using a 6-French, 23 cm radial sheath in the right radial artery. Findings were significant for mild to moderate non-obstructive coronary artery disease of distal left anterior descending and mild to moderate restenosis of previously placed drug-eluting stent in proximal left anterior descending. Bivalirudin, with an initial bolus 0.75 mg/kg followed by 1.75 mg/kg/hr for the duration of procedure, was used for anticoagulation. The radial artery sheath was immediately removed after completion of coronary angiography and hemostasis was achieved by application of a radial compression bandage. Patient tolerated the procedure well without any complications. His chest pain was deemed to be multifactorial, attributed to chronic pain syndrome and esophagitis. His antianginal treatment was optimized at the time. Post-op day three of cardiac catheterization the patient started to complain of right wrist discomfort, which he described as achiness and warmth over the right radial catheterization access site. He denied numbness or finger claudication. Allen's test performed at the bedside was negative. An ultrasound with color Doppler imaging showed a fistulous connection between the radial artery and radial vein that demonstrated a biphasic waveform with a peak systolic velocity of 100.7 cm/s. A pressure device was used for conservative management of his AV fistula (Figure 1). A repeat ultrasound next day showed resolution of previously demonstrated AV fistula (Figure 2). Patient was subsequently discharged home with optimized antianginal management. One month later, the patient returned to the hospital for recurrence of his chest pain and uncontrolled diabetes. During this visit, he complained of warmth and achiness in his right wrist. Color Doppler ultrasound of wrist showed normal venous waveforms without definite fistula formation.

There was no evidence of acute coronary syndrome and patient was subsequently discharged home on the same medication regimen. Two months later, the patient was hospitalized with similar chest pain. His chest pain was determined to be due to chronic chest pain syndrome and no further cardiac workup was pursued. He once again complained of persistent pain in his right wrist. Physical exam findings demonstrated a good right radial pulse with the presence of bruit and no palpable thrill.



**Figure 1:** Right upper extremity (RUE) ultrasound from January 25, 2018 demonstrating arterialized waveforms in radial vein consistent with arteriovenous fistula.



**Figure 2:** RUE arterial ultrasound from January 26, 2018 showing resolution of previously visualized arteriovenous fistula.

## Discussion

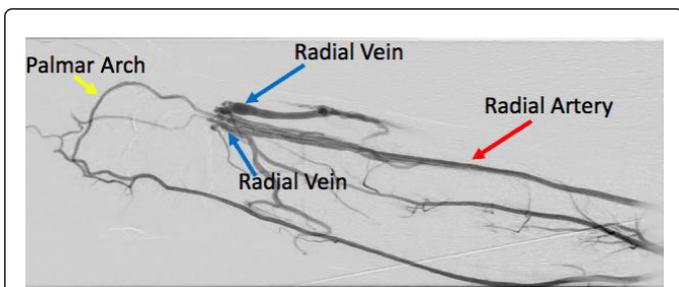
In comparison with transfemoral access, data collected from studies has suggested that transradial approach (TRA) has been associated with less bleeding complications, reduced cost, decreased hospital mortality, and fewer access site complications as compared to transfemoral approach [1]. In a recent prospective Radial Versus Femoral Randomized investigation in ST elevation Acute Coronary Syndrome (RIFLE-STEACS) trial, subjects with ST elevation MI (STEMI) undergoing primary percutaneous intervention (PPCI) were randomized between transfemoral versus transradial arterial access. This study enrolled 1,001 patients across four Italian centers and found not only a 47% reduction in the rate of access-site-related bleeding complications, but also a reduction in the rate of hospital stay and cardiac death with transradial procedure [2]. In another recent prospective registry of 507 patients undergoing TRA coronary catheterization, vascular complications were detected in 12 patients (2.36%), radial artery occlusion was detected in 9 patients (1.77%), 2 patients had pseudoaneurysms (0.38%), and 1 patient developed AV fistula (0.19%) [3].

In the largest randomized trial to compare radial and femoral access to date, the MATRIX (Minimizing Adverse Hemorrhagic Events by Transradial Access Site and Systemic Implementation of AngioX study), included 8,404 subjects with acute coronary syndrome (ACS) undergoing intervention. In patients with NSTEMI-ACS, the use of radial access significantly reduced both co-primary outcomes of NACE (net adverse clinical events) and MACE (death, myocardial infarction, or stroke), as well as all-cause mortality and cardiac mortality. In patients presenting with STEMI, the use of radial access did not formally reduce all-cause mortality or cardiac mortality [9]. Interestingly, a similar study, the RIVAL (Radial vs. Femoral Access of Coronary Intervention) trial, compared TRA with TFA in 7,021 patients presenting with ACS. The primary outcome, like in MATRIX trial, was defined as MACE, a composite of death, myocardial infarction, stroke, or non-coronary artery bypass graft surgery related major bleeding within 30 days. Although the incidence of the primary outcome was not significantly different between the radial and femoral approaches, major vascular complications, defined as large hematoma, AVF, ischemic limb needing surgery, and pseudo aneurysm occurred in 1.4% of subjects with TRA as compared to 3.8% of subjects with TFA ( $P < 0.001$ ). In the RIVAL study, none of the 3507 patients in the TRA group were reported to have an AV fistula, whereas 5 (0.14%) of 3514 subjects in TFA group had an AV fistula [10].

Iatrogenic post-catheterization femoral AV fistula is not uncommon, owing to arterial access in the groin for percutaneous cardiovascular procedures. Puncture below the common femoral artery is the main culprit of post-catheterization AV fistulas [7]. The incidence is higher in therapeutic compared to diagnostic catheterization (0.87% vs. 0.15%) [11,12]. AV fistula formation with TRA is rare and has been infrequently reported [8]. Iatrogenic AV fistulas result from penetration of a needle through arterial and venous tributary during angiographic catheterization procedures rarely, when the communication between the artery and vein does not seal spontaneously, an AV fistula forms. Incidence of iatrogenic AV fistula formation can be minimized with operator experience, using a sheath size smaller than arterial diameter, and limiting repeated access of same artery. Furthermore, ultrasound-guided needle placement can be helpful in providing anatomical information such as proximity of the radial artery to the vein.



**Figure 3:** RUE arterial ultrasound from April 18, 2018 shows paired radial veins with arterIALIZED waveforms approximately 7 cm from wrist. A fistula between the radial artery and vein is apparent on grayscale imaging. Adjacent dilated cephalic vein at the wrist with arterIALIZED waveforms.



**Figure 4:** Conventional Angiography from April 19, 2018 demonstrates rapidly filling and abnormally enlarged radial veins adjacent to the radial artery consistent with an arteriovenous fistula. Increased number and caliber of draining veins are also visualized on delayed imaging. Patent palmar arch is present.

Doppler color ultrasound confirmed the formation of an AV fistula between radial arterial and radial vein (Figures 3 and 4). He subsequently underwent endovascular embolization of his right AV fistula. Allen's test after the procedure was negative. Patient tolerated the surgery well with resolution of the AV fistula and all associated symptoms.

The largest study to date on incidence and clinical outcomes of AV fistulas found that predictors of AV fistula formation were puncture of left groin, female gender, arterial hypertension, Coumadin therapy, and high heparin dosage during the procedure [13]. Our patient had none of these risk factors and his right radial artery was accessed after the first procedure without any complications.

The prognosis of an uncomplicated AV fistula is usually good. Post-catheterization AV fistulas are not generally life threatening and close spontaneously. They are associated with serious complications such as high output cardiac failure with a large AV fistula, aneurysm degeneration of the artery, and limb edema [14]. In large AV fistulas, significant hemodynamic shift can occur from the high systemic vascular resistance in the artery to the lower resistance in the vein. Increased venous return increases stroke volume, which can potentiate high output heart failure.

In the setting of preexisting peripheral vascular disease, high-flow AV fistulas can reduce blood flow to the lower extremity which can lead to the onset or worsening of lower extremity ischemic symptoms [15]. In a study of 81 lower extremity AV fistulas, 46(81%) of 57 patients not requiring immediate surgical repair had spontaneous resolution of the AVF within an average mean of 23 days [16]. In another prospective study the incidence of AV fistulas was 0.86% (n=88) among a total of 10,271 consecutive patients undergoing cardiac catheterization over a period of three years. Within 12 months, 38% of all AV fistulas closed spontaneously [13].

Patients with a persistent iatrogenic AV fistula can be managed conservatively, medically, or surgically. First, conservative management with observation is a viable option for femoral AV fistulas as most of this close spontaneously. This case challenges a report that TRA approach can be managed conservatively [4]. Second, implantation of a covered stent can be used for the femoral artery [17,18]. As our patient underwent TRA catheterization, a stent would be a poor given the small size of the artery and the possibility of restenosis. Third, continuous low-pressure compression using a hemostatic band can be implemented for radial AV fistula following transradial approach [19]. A pressure device was initially used for conservative noninvasive treatment in our patient. This is a rare report of iatrogenic radial AV fistula that was noninvasively repaired using a pressure device. Fourth, until now surgical repair approach has been advocated as the intervention of choice for cases of AV fistula resulting from TRA [18,20]. Surgical options depend on the size of AV fistula and include surgical ligation, excision and repair. This is an invasion option associated with operative morbidity and mortality. Our patient did not require a surgical intervention for repair of AV fistula. Fifth, post-catheterization femoral AV fistulas have been treated successfully with percutaneous and endovascular embolization [21,22]. Our case is the first case of iatrogenic TRA AV fistula that was managed successfully with endovascular embolization. This case further challenges the current practice that AV fistula caused by use of the TRA approach needs to be addressed surgically or conservatively, as was the case in all the previous publications describing this complication [8,20]. It is our opinion that endovascular or percutaneous embolization is a superior alternative to conservative or surgical management for radial AV fistula. Additionally, TRA catheterization cases of AV fistula that are first managed conservatively with a pressure device should be repaired with embolization over surgical intervention.

## Conclusion

Iatrogenic AV fistula is a rare vascular complication of transradial coronary angiography may be treated with embolization rather than conservative management or surgical intervention. Furthermore, cases of AV fistula resulting from TRA catheterization that initially fail the conservative management should be repaired with embolization.

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