

All Roads Lead to the Heart: A Case of Transulnar Approach for Coronary Catheterization in a Patient with Limited Access Routes

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Abstract

Introduction: In a time of increasing use of forearm arterial access in cardiac catheterization, the reported use of the ulnar artery remains low. However, in the patient population with heavy cardiovascular disease burden, it is not uncommon to have patients requiring either multiple catheterizations, future coronary bypass, or other additional procedures which may compromise arterial anatomy. Previously thought to require longer access time, several large meta analyses have shown comparable access time and failure rates to radial access.

Case presentation: We present a case of a 51-year-old male who underwent successful translunar access for cardiac catheterization in the post-bypass setting with limited arterial access points. Presenting with an eight-month history of angina and positive stress test, he was found to have multivessel disease on initial catheterization. He underwent four vessel bypass using LIMA, RIMA, left radial artery, and left great saphenous vein. On post-op day two, he went into cardiac arrest requiring CPR and multiple vasopressors. He was subsequently placed on venoarterial ECMO with arterial access at his right femoral artery after failed access on his left femoral artery. With a new drop in ejection fraction, he returned to the lab for right and left catheterization. With recent failed L femoral access, ongoing use of R femoral artery for ECMO, harvest of L radial for bypass, and a failed Allen's test on his R radial, the decision was made to use the R ulnar artery. Arterial access was successful, and PCI was performed on a severely stenotic lesion of the distal RCA. Ejection fraction returned to 55-60%, and he was weaned off ECMO.

Discussion: This case demonstrates opportunity for translunar catheterization and reviews literature demonstrating comparable outcomes to radial access.

Keywords: Transulnar; Catheterization; Coronary artery; Femoral artery; Bypass grafts

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Introduction

Over the past two decades, there has been an increase in the use of forearm arteries for coronary angiography relative to the femoral artery. Compared to femoral arteries, forearm arteries are more easily compressible, minimizing hematoma risk and allowing for earlier patient ambulation, with the only drawbacks being 4-8% crossover rates to another artery and 6-8% incidence

of asymptomatic radial artery (RA) occlusion [1]. This failure rate for transradial access (TRA) as well as desire to preserve the integrity of the RA for future bypass grafts prompted initial trial for translunar coronary angiography by Terashima in 2001. However, the use of translunar access (TUA) has been rare compared to TRA in terms of efficacy despite similarities in their caliber and perfusion. Suggested benefits of using the ulnar artery (UA) include preserving an intact RA for future coronary artery

grafting, serving as an alternative backup to failed TRA before attempting a transfemoral route, and serving as an alternative to the RA in hemodialysis patients [2]. Despite these potential benefits, only 3.3% of interventionalists preferred using the UA after a failed radial attempt [3]. Arguments against the TUA have included difficulty to palpate the UA relative to the RA, longer procedure times as well as higher crossover rates compared to the radial artery.

We report a case of patient who underwent coronary catheterization with ulnar access after a recent coronary artery bypass grafting (CABG) due to limited options for access.

Case Report

A 51-year-old male with history of hyperlipidemia, diabetes mellitus type II, and obesity was seen by cardiology for anginal chest pain over eight months. He had a positive nuclear stress test that showed a 2 mm ST depression in the anterolateral and inferior leads as well as moderate reversible ischemia on imaging in the anterior, anteroseptal, and apical myocardium with mild septal hypokinesis. The patient underwent coronary angiography which showed the following levels of stenosis in the arteries: 65% in the left main (LM), 80% in the proximal left anterior descending (LAD), 80% in the 1st diagonal (D1), 60% in the proximal left circumflex (LCx), 50% in the mid LCx, 30% in the proximal right coronary artery (RCA), and 75% in the mid RCA. The decision was made to proceed with CABG for the multivessel disease.

Pre-operative echocardiography showed a normal ejection fraction (EF). The patient's left and right internal mammary arteries (LIMA, RIMA), left RA, and left great saphenous vein (GSV) were all found to be of good quality and caliber. The patient underwent a four-vessel CABG, including LIMA to LAD, free RIMA T-graft from LIMA to obtuse marginal (OM), SVG to D1, and radial to right posterior descending artery. There were no complications during the procedure, and the graft flows were brisk. Patient initially had an uncomplicated post-operative course and was progressing with inpatient cardiac rehab.

However, two days after the CABG, the patient had a witnessed cardiac arrest while attempting to have a bowel movement. CPR was performed with return of circulation in approximately 10 minutes. A transesophageal echo was done which showed significant right ventricular dilatation with normal left ventricular function despite the significant LAD disease, leading to concerns for a pulmonary embolus. The patient was profoundly hypoxemic despite max doses of epinephrine, norepinephrine, and vasopressin. The decision was made to start venoarterial extracorporeal membrane oxygenation (VA ECMO). An attempt was made in the left femoral artery but this was unsuccessful due to kinking of guidewire. ECMO was thus placed in the right femoral artery. A repeat echo the following day showed persistent reduction in the EF (15-20%) and severe reduction in both left and right ventricular systolic function. The interventional cardiologists decided to do a right heart catheterization with pulmonary angiography to determine if a pulmonary embolus was present, and if there was not, to perform coronary angiography to investigate graft patency. However, as the L femoral artery was unavailable due to recent injury from

ECMO placement, the R femoral artery was being used for ECMO, the L radial artery was harvested earlier for graft, and the R radial artery was found to be unsuitable on Allen test, the decision was made to use the R ulnar artery. TUA was achieved with no issues under ultrasound guidance. The right heart catheterization did not show any evidence of pulmonary embolism, while the left heart catheterization showed patent grafts and severe distal RCA stenosis that was intervened with a drug-eluting stent, with 0% residual stenosis and TIMI 3 flow. Three days after stenting, the patient's LVEF on echo improved to 55-60%. After closely monitored ICU care, patient was gradually transitioned to VV ECMO and was eventually weaned off ECMO.

Discussion

The rise of radial catheterization has been one of the most important developments in interventional cardiology over the past few decades. The rate of major adverse cardiac events (MACE) has been comparable between transradial and transfemoral approaches, but the transradial approach has been shown to be significantly superior to femoral access in terms of vascular site complications (0.3% to 2.8%), albeit with the drawback of increased procedural failures (7.2% to 2.4%) [4]. There has also been an economic benefit with reduced mean hospital stays and total hospital charges, all favoring transradial approaches.

However, there are limitations even with the radial artery, including a 10% incidence of radial artery spasm and a 5% prevalence of anatomic variants [5]. In addition, if a radial artery is occluded, it can no longer be used for future cardiac catheterization or bypass grafts and dialysis fistulae. On the other hand, the ulnar artery has been reported to have less anatomical variations with fewer loops and tortuosity and has been shown to have fewer adrenergic receptors, reducing the rates of spasm [6]. By also attempting ulnar access first, the radial artery can be preserved for future use in other medical therapies.

The AJULAR catheterization study showed that ulnar catheterization was safe and feasible in a prospective study of 2,532 patients [7]. When performed by a single experienced operator (>150 radial procedures per year), no difference was noted in number of cannulation attempts, procedure time, or total fluoroscopy time compared to radial access. However, in inexperienced physicians, all outcomes were increased compared to radial access. This was a significant conclusion that contradicted previous concerns over increased time to ulnar artery access over radial artery access due to anatomic depth [7].

In a small prospective trial by Vassilev, et al., when used under criteria of a palpable ulnar pulse and positive modified Allen's test, TUA had an equally low complication rate of less than 1% [3]. The same study found the most common failure rate to be the inability to advance the guidewire despite adequate arterial flow, suggestive of anatomic variants. However, the radial artery has consistently been found to have higher rates of anatomic loops and kinks than the ulnar artery [3].

The most recent systematic review and meta-analysis of 6 randomized RCT's to investigate the safety and efficacy of ulnar artery approach showed that TUA was noninferior to TRA in the

incidence of MACE [8]. In addition, there was no significant difference in the incidence of bleeding, hematoma formation, or in mean arterial access time between the two approaches. There was a trend towards higher access site failure, but no statistical significance was met [8].

The promising outlook for TUA approach has brought up the question of use intraoperatively when radial access has failed from occlusion. As mentioned, this failure rate is as high as 10% in TRA, and transition to an ipsilateral TUA could save time spent on femoral or contralateral radial preparation. Kedev et al. studied the outcomes of 504 consecutive patients that underwent TUA due to ipsilateral radial artery difficulties including inability to puncture the RA, absent or weak pulses, dissection, or non-crossable loops.⁹ In 240 of these patients that underwent TUA in the specific setting of an ipsilateral radial artery occlusion, no difference was found in procedural outcome, vasospasm, hematoma, or major vessel complications compared to the rest of the cohort with patent radial artery. Additionally, none of

these patients showed signs of hand ischemia after thirty-day follow-up. When both radial and ulnar arteries are compromised such as in these settings, collateral perfusion is maintained almost entirely by branches of the interosseous artery. This study directly supports our use of the TUA in the setting of reduced ipsilateral radial perfusion [9].

Conclusion

Therefore, TUA for coronary angiography should be considered an acceptable alternative to the radial artery, especially in the setting of multiple interventions and possibility of needing radial harvest for CABG. While evidence exists that this is safe in setting of ipsilateral radial artery occlusion, this should generally be reserved for emergency settings due to uncertainty of quality of collateral perfusion in individual patients [9]. A pre-procedure ultrasound evaluation of the distal ulnar and radial arteries is a worthwhile time investment to ensure adequate target vessel diameter and thus reduce vasospasm and crossover [10].

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