

Transradial Access for ACS and STEMI

A literature review revealing why transradial access should be the standard for coronary imaging and interventions.

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The radial approach for diagnostic angiography and other cardiac interventions was initially described more than 2 decades ago, and since then, several clinical trials ranging from small observational studies to multicenter trials have been conducted to establish the significance of access site selection for patients requiring such procedures.¹⁻⁸ Interventionists have frequently contended that although radial access results in decreased vascular complications, it is often accompanied by technical difficulties and increased radiation exposure, making the procedure less enticing.

However, in recent years, the MORTAL,⁹ RIVAL,² HORIZONS-AMI,^{1,10} and RIFLE-STEACS³ trials have finally provided substantial evidence that, in addition to reduced access site bleeding, the use of the radial approach results in a mortality benefit in patients presenting with ST-elevation myocardial infarction (STEMI). Specifically, a 44% reduction in all-cause mortality² and a 60% reduction in cardiac death in patients presenting with STEMI³ have been demonstrated. Furthermore, the radial approach is increasingly the patients' preferred method for such procedures, thus compelling experts to seriously study and consider a transition from the traditional transfemoral approach. In this article, we review and document the clinical trials that have helped the radial approach to gain momentum toward plausibly becoming the standard access site for cardiac interventions, especially in the setting of STEMI.

Cardiac catheterization has come a long way since Hales' first equine biventricular catheterization in 1711.¹¹ Although Forssmann pioneered the techniques used in cardiac catheterization in 1929, numerous skilled physicians have since honed the procedure and equipment used in the practice (eg, Charles T. Dotter, Sven I.

Seldinger, F. Mason Sones, Melvin P. Judkins, Kurt Amplatz, and Andreas R. Gruentzig).¹² Campeau et al originally used transradial coronary intervention back in 1989¹³; however, due to the familiarity of the femoral procedure and the availability of appropriate equipment, interventionists have heavily favored transfemoral coronary intervention as the preferred vascular access method for PCI.

Now, transradial coronary intervention is gaining impetus and is progressing to be the new trend in interventional cardiology due to current data demonstrating that transradial access has better procedural outcomes, low vascular entry site complications, and decreased mortality rates compared to transfemoral access. Current statistics indicate that more than 1.5 million hospitalizations in the United States are due to coronary artery disease manifesting as an acute coronary syndrome (ACS),¹⁴ and more than 1.2 million PCIs are performed in the United States annually.¹⁵ Hence, there is a pressing need to decrease the billions of dollars spent on the health care of these patients in terms of procedural complications and rehospitalizations.

CLINICAL TRIALS AND OUTCOMES WITH THE TRANSRADIAL APPROACH

Major bleeding is one of the most common complications of current cardiac interventions and pharmacologic therapies for ACS, which includes both STEMI and non-STEMI. Based on observational studies and small meta-analyses, Rao et al and others predicted an association of bleeding severity with an increased risk of death and recurrent ischemic episodes¹⁶⁻¹⁸; their initial analysis showed that the radial access route had better outcomes compared to the conventional femoral approach. However, the findings

received significant criticism because the studies were small, single center, underpowered, and had various confounding factors.^{4,9,19} Consequently, several further trials have studied the issue, and this review outlines the observations of these trials and their contribution in making transradial angioplasty as an attractive alternative to the established femoral approach for cardiac interventions.

Despite being retrospective and nonrandomized, MORTAL was one of the early studies that directly evaluated the relationship of the arterial access site during PCI and 30-day/1-year mortality.⁹ Using transfusion as an alternative to bleeding, the study established that patients who underwent radial access experienced reduced bleeding compared to those who underwent femoral access, with transfusion rates halved in the radial group (odds ratio, 0.59; $P < .001$). More importantly, a significant finding of the trial was that patients undergoing transradial coronary intervention had decreased 30-day and 1-year mortality compared to transfemoral coronary intervention patients (1% vs 1.7% at 30 days and 2.8% vs 3.9% at 1 year). Although the strength of the study was its large patient numbers, it hugely depended on statistical methods to ascertain associations and to control for differences; hence, it was imperative to confirm the findings by randomized trials.

To this extent, the randomized RIVAL trial was performed to compare the transradial and femoral approaches for coronary angiography.² RIVAL was a parallel group, multicenter, international trial involving 7,021 patients from 32 countries, and to date, it remains the largest trial comparing the two approaches for coronary interventions. The primary outcome of the RIVAL trial was a composite of death, MI, stroke, or non-coronary artery bypass graft-related major bleeding at 30 days. Although the overall RIVAL trial results did not demonstrate a difference in primary outcomes between the two groups, it has unraveled effects of the radial approach that mandate further investigation.

First, the study demonstrated that in patients with STEMI, radial access showed better primary outcomes compared to patients with non-STEMI (3.1% vs 5.2%; $P = .025$). Second, using the criteria for major bleeding as defined in RIVAL,² the trial did not show significant differences in the primary outcomes between the two groups (3.7% vs 4%; $P = .5$). However, using the bleeding definition from the ACUTY trial,²⁰ radial access had significantly lower bleeding rates compared to femoral access ($P < .0001$). Third, RIVAL revealed that non-coronary artery bypass graft-related major bleeding was significantly lower in the radial access group (0.6% vs 1.9%; $P = .025$). Fourth, based on their updated meta-analysis of randomized trials, the group also found that vascular complications were significantly lower in the radial access cohort in comparison to the femoral group (1.4% vs 3.7%; $P < .0001$).²¹ Finally, the study indicated that

in the primary PCI cohort, the radial access group had a 54% reduction in mortality at 30 days compared to the femoral access group. Although RIVAL has provided valuable insights into the use of the radial approach for PCI, it still is used in $< 10\%$ of PCI procedures worldwide, a strong indication that the jury is still undecided and hence the need for a well-powered and controlled study that could corroborate the findings seen in RIVAL.

Therefore, RIFLE-STEACS, a multicenter, randomized, controlled study was initiated in 2009 to determine whether the radial approach had significant advantages over the standard femoral approach in STEMI patients.³ RIFLE-STEACS established that (1) STEMI treatment resulted in better outcomes if PCI was performed via the radial route (13.6% vs 21%; $P = .026$), (2) a reduction in access site bleeding in the radial group (2.6% vs 6.8%; $P = .002$) resulted in a decreased need for blood transfusion (1% vs 3.2%; $P = .025$) and a lower number of cardiac deaths compared to the femoral access group (5.2% vs 9.2%; $P = .02$), and (3) patients who had radial access spent fewer days in hospital (4–7 vs 5–8 d; $P = .008$) and fewer days in the coronary care unit (2–4 vs 3–5 d; $P < .001$) in contrast to the femoral group.

It is important to note that a high number of hemorrhagic events were noted in RIFLE-STEACS compared to previous studies, and this could be attributed to the inclusion of patients with critical conditions, such as cardiogenic shock and failed thrombolysis, which resulted in significant use of glycoprotein IIb/IIIa inhibitors in this patient cohort. That being said, post hoc analysis of the HORIZONS-AMI study, which compared bivalirudin alone and heparin plus a glycoprotein IIb/IIIa inhibitor in patients with STEMI undergoing primary PCI, also revealed that radial access was associated with decreased bleeding and reduced ischemic episodes.^{1,10} The latter suggests that the radial approach attenuates the benefits of novel periprocedural antithrombotics such as bivalirudin in STEMI; however, a dedicated trial that addresses the association of anticoagulation type used, access site bleeding, and outcomes would help to clarify the issue.

DISCUSSION

There are substantial life-threatening complications (eg, large hematomas, retroperitoneal bleeds, pseudoaneurysms, and arteriovenous fistulas) associated with the femoral approach for PCI, and there is significant literature outlining the benefits of the radial approach, yet interventionists have been hesitant to take the leap and adopt the radial approach as the primary access for cardiac interventions. Possible explanations for this caution could be (1) the technical difficulty of the route, (2) a steep learning curve for the operator, and notably (3) a lack of defined mechanisms for the positive outcomes demonstrated by the radial

approach. Nonetheless, the data from RIVAL and RIFLE-STEACS provide compelling evidence and make a strong argument for the change from femoral to a radial-first approach for cardiac interventions.

The RIVAL and RIFLE-STEACS trials are a few of the first studies to directly address the question of the appropriate approach for coronary angiography in patients with STEMI. Notwithstanding the differences in patient populations, both studies have revealed that the use of radial access is linked with better outcomes and decreased mortality.²² Logically, the decreased access site bleeding that we know is linked to risk of ischemic events has translated to these significant decreases in mortality and better PCI outcomes with the radial approach.

Further, advantages of the radial approach are that limb damage is unlikely because the radial artery is well separated from the median nerve and major veins of the forearm and because the limb receives collateral blood supply from the ulnar artery. Although 5% to 7% of the general population have variations in arterial anatomy, and conceptually, patency of the ulnar artery by the Allen's test or oximetry/plethysmography seems useful, no hard endpoint data confirm the utility of such testing prior to performing transradial coronary interventions. Furthermore, appropriate patient selection, as per the guidelines of the transradial committee of the Society for Cardiovascular Angiography and Interventions, could help mitigate the inherent challenges of the procedure. Lastly, it is important that the practitioner generally perform adequate volume of transradial coronary interventions. This is especially important because the RIVAL trial showed that the benefits of the radial approach were optimal in centers with radial intervention volumes in the upper tertile (> 147 interventions annually).

CONCLUSION

The transradial approach has become the gold standard access site in ACS and STEMI given the improvements in hard endpoints that we have seen in the clinical trials to date. Therefore, it makes sense that transradial access would be the preferred option in most coronary angiography and interventions to maintain adequate skill sets and expertise. Exceptions to this will remain and include patients on renal dialysis with arteriovenous fistulas and radial, brachial, or brachiocephalic anatomy that is unfavorable. Femoral artery access will remain the access site of choice for large-bore sheath delivery, as is required in transcatheter valve implantation. However, for the coronary interventionist, radial artery access will be the future mainstay of arterial access. ■

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