



Editorial

Transradial Access for Peripheral Endovascular Interventions: A Leap Toward Improved Patient Safety and Improved Clinical Outcomes

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Interventional cardiology has revolutionized the percutaneous options for coronary revascularization since its inception in the 1980s. One innovation was transradial access (TRA) for coronary angiography and interventions. Lucien Campeau, MD, performed the first radial angiogram in 1989 at the Montreal Heart Institute.¹ Dr Campeau published a paper that proposed using 5F diagnostic catheters to access radial arteries to reduce the rate of bleeding complications. The early 1990s saw a rapid shift in coronary balloon angioplasty from a standalone procedure to stenting. Stent thrombosis continued to be a risk, and multiple anticoagulation strategies were used. This, in turn, led to vascular access bleeding. Radial access was considered an ideal access site to reduce bleeding access complications during coronary interventions. Dr Ferdinand Kiemeneij performed the first transradial coronary procedure on August 14, 1992.² Over the next 3 decades, despite slow progress, we saw the switch from femoral to radial access, the primary access for safety and lower bleeding complications.^{3,4} Once considered in selected patients with 4F diagnostic catheters, TRA is now used with 7F catheter access to perform complex coronary interventions, including atherectomy and chronic total occlusions.

Transradial access for peripheral interventions has been shown in a few studies and reports to be safe and feasible.⁵⁻⁷ Initial cases were reserved for subclavian and aortoiliac lesions and renal and mesenteric arteries. Safety of TRA for below-the-knee interventions has been well demonstrated by Alex Sher and colleagues.⁸ Complex peripheral interventions such as carotid interventions can be safely performed, and a recent randomized trial of TRA vs the femoral approach for carotid stenting showed high crossover rates. The procedure duration and fluoroscopy time were similar with both accesses; however, radiation was higher with TRA.⁹

The numerous benefits of TRA, such as reduced bleeding, reduced vascular complications, reduced mortality, reduced costs, early ambulation, and shorter hospital stays, have increased its use for peripheral vascular interventions, but the adoption of TRA for peripheral vascular interventions has been slow. Less than 1.5% of all endovascular interventions in the United States utilize TRA, although it is gaining traction across endovascular disciplines. To be successful with TRA in

peripheral interventions, more diminutive equipment and extended treatment platforms are warranted. The complications of TRA interventions, including radial hematoma, pseudoaneurysm, radial artery spasm, dissection, occlusion, thrombus, arteriovenous malformation, compartment syndrome, vessel injury, arm bleeding, and arm amputation, are extremely rare. The Radial to Peripheral Interventions (R2P) registry was established to prospectively evaluate the safety and feasibility of TRA for complex endovascular lower extremity interventions to address this gap.

The R2P registry is a prospective, multicenter, observational, post-market study that enrolled patients with symptomatic peripheral artery disease (PAD) and Rutherford class 2 to 5 symptoms.¹⁰ The study was conducted at 8 participating US centers from June 2020 to June 2021. TRA was successfully obtained in all enrolled patients, and various devices were used to treat the target lesions.

The registry included 120 patients, and TRA facilitated the completion of complex and multilevel lower extremity endovascular interventions with high technical success rates (93.3%) and meager complication rates. Only 1 case required conversion to femoral access due to anatomical challenges. Additional retrograde access sites were necessary for lesion crossing and treatment delivery in 25% of cases, most commonly in the pedal and tibial regions. No serious adverse events were reported, and only minor complications, such as access site bleeding and pseudoaneurysm, were observed.

The study's findings demonstrate that TRA is a safe and effective approach for treating complex multilevel PAD. The technique allowed for early ambulation and same-day discharge for most patients, further enhancing patient satisfaction and reducing health care costs. Notably, there were no serious adverse events associated with the TRA procedure. The low rate of radial artery occlusion at 30 days suggests it is consistent with trials using TRA for cardiac catheterization and further supports excellent vascular access outcomes.

The R2P registry highlights the promising potential of TRA for peripheral endovascular interventions. With its high technical success rate, low complication rate, and patient-friendly advantages, TRA should be considered a viable alternative to transfemoral access. Further

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randomized trials are needed to compare the clinical and cost-effectiveness of TRA vs transfemoral access for patients with PAD. Embracing the radial approach for peripheral interventions has the potential to revolutionize the field of endovascular treatments to improve patient outcomes and increase access safety.

The future of radial artery interventions appears promising, given the numerous advantages demonstrated in this study and the well-established benefits observed with TRA in coronary interventions. As the field of endovascular treatments continues to advance, several vital aspects can shape the future of radial artery interventions.

Increased adoption

With mounting evidence of the safety and efficacy of TRA in peripheral interventions, the adoption of this approach will likely continue to grow. As more interventionalists become comfortable and experienced with radial access techniques, the utilization of TRA for peripheral interventions may become more widespread.

Technological advancements

The development of newer devices and technologies designed explicitly for TRA can further enhance the feasibility and success of peripheral interventions. Longer shaft lengths in devices and advancements in equipment for radial interventions can improve the treatment of distal lesions, making it easier for operators to access and treat complex anatomy. Additionally, developing lower profile covered stents will enhance treatment options and procedural safety.

Comparative trials

Future randomized trials that directly compare the outcomes of TRA and transfemoral access for peripheral interventions will be crucial in guiding clinical practice. These trials should assess technical success and complication rates, long-term clinical outcomes, patient satisfaction, and cost-effectiveness.

Operator training and education

Adequate training and education for interventionalists in TRA techniques are essential for ensuring the safe and effective implementation of this approach. Incorporating TRA training in interventional cardiology and vascular training programs can help future physicians become proficient in radial interventions.

Although the R2P registry provides valuable insights into the safety and feasibility of TRA for complex peripheral endovascular interventions, some limitations should be acknowledged. The study design did not include a control group using femoral access for comparison. A direct comparison between TRA and transfemoral access in the same cohort makes it easier to determine the advantages of radial access over the traditional femoral approach. The enrollment of patients at the discretion of the interventionalist may introduce selection bias, as operators may have chosen fewer complex cases for TRA. This could lead to overestimating the success rates and safety outcomes

observed in the study. The study's follow-up duration was only 30 days, which may not capture long-term outcomes or complications associated with TRA, such as late radial artery occlusion or restenosis. Finally, while the study enrolled 120 patients; a larger sample size would have provided more robust data and allowed for subgroup analyses to evaluate the impact of TRA in specific patient populations. Despite these drawbacks, the R2P registry provides valuable preliminary data supporting using TRA for peripheral interventions.

Conclusions

Future studies should address these limitations and provide more comprehensive evidence to further validate the benefits of radial artery interventions. The industry works with interventionalists to better understand peripheral anatomy and equipment requirements. This has led to longer shafts for our balloons and stents that will fit through smaller-diameter sheaths. Ultimately, as the peripheral domain catches up to the coronary arena, interventionalists already comfortable with TRA should adopt this access site. Ultimately, the patient may benefit the most with the potential for reduced access complications and earlier ambulation and discharge.

Declaration of competing interest

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