ASK THE EXPERTS

Maintaining Low Complication Rates as Radial Access Advances

Perspectives on minimizing radial access–related events in an increasingly complex procedural landscape through careful patient selection, procedural planning, and knowing when to change your access strategy.

With Aaron M. Fischman, MD, FSIR, FCIRSE, FSVM; Justine M. Aziz, MD; Benjamin D. Gross, MD; Vera Sharashidze, MD; and William E. Beckerman, MD, FSVS, FACS, RPVI



Aaron M. Fischman, MD, FSIR, FCIRSE, FSVM
Professor of Diagnostic, Molecular, and Interventional Radiology, Urology, and Surgery
Icahn School of Medicine at Mount Sinai
New York, New York
aaronfischman@mountsinai.org
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Justine M. Aziz, MD
Department of Diagnostic, Molecular, and Interventional Radiology
Icahn School of Medicine at Mount Sinai
New York, New York
Disclosures: None.



Benjamin D. Gross, MD
Department of Diagnostic, Molecular, and Interventional Radiology
Icahn School of Medicine at Mount Sinai
New York, New York
Disclosures: None.

As radial access expands to more complex interventions, the fundamentals of radial technique remain essential. Transradial access (TRA) has been used across a broad range of embolization procedures for more than a decade, with a highly standardized approach.[1] The initial assessment should focus not only on whether the radial artery can be accessed but also on whether it is suitable for the planned procedure and can be preserved for future use. Ultrasound evaluation provides important information regarding radial artery caliber, patency, and anatomic course. A vessel that is too small for the intended sheath or that has been previously injured is often better left alone. Assessment of collateral hand perfusion should also be performed with the Barbeau test, which evaluates the plethysmographic response to radial artery compression. An abnormal Barbeau response, particularly a type D waveform, should be interpreted in conjunction with the clinical examination and ultrasound findings rather than used in isolation as an absolute contraindication to radial access.[2] Once radial access is selected, ultrasound-guided puncture should be performed, and the smallest sheath that will reliably accommodate the planned procedure should be used. Hydrophilic sheaths should be considered mandatory, particularly when long sheaths are advanced from the radial artery for complex interventions, as they

facilitate device passage and reduce the risk of severe radial artery spasm and vessel trauma during sheath manipulation and removal. Adequate anticoagulation and vasodilator therapy—typically an intra-arterial cocktail of heparin with nitroglycerin and/or a calcium-channel blocker—are particularly important as procedures become longer and require more catheter manipulation. Radial artery preservation should remain a consideration throughout the procedure rather than simply focusing on successful access.

For more complex procedures, the access strategy should be determined prior to the procedure. Catheter length, sheath size, and devices needed to complete the intervention should all be considered. Left radial access remains our preferred approach for most infra-diaphragmatic work when anatomy allows because it shortens the working length and limits catheter transit across the aortic arch. The aortic arch still deserves particular attention whenever the catheter path crosses it. Catheter and wire manipulation within the arch can potentially dislodge aortic atheroma and result in cerebral embolization, although clinically evident stroke appears to be uncommon in visceral transradial interventions.[3,4] A 2025 retrospective study of 98 patients undergoing left transradial visceral intervention found that the median time required for catheter manipulation within the aortic arch was 26 seconds; manipulation > 30 seconds was classified as technically difficult, but no adverse events related to arch manipulation were observed.[3] This study suggests that 30 seconds may serve as a marker of increasing technical difficulty rather than a validated threshold for stroke risk. In practice, the goal should be to traverse the arch efficiently and atraumatically. Gentle wire advancement under fluoroscopic guidance, avoidance of forceful probing, appropriate catheter selection, and minimization of catheter exchanges can limit unnecessary manipulation. When the catheter does not readily enter the descending aorta, repeated forceful attempts should be avoided. A different catheter configuration may be preferable to prolonged manipulation. Preprocedural cross-sectional imaging can also be useful when complex arch anatomy or significant aortic atherosclerosis is suspected.[3,4] Importantly, catheter exchanges and catheter removal should be performed over a wire whenever feasible to maintain wire access and minimize uncontrolled catheter movement, particularly when the catheter has traversed the arch and is positioned across the vertebral artery origins. Efficient catheter manipulation remains important throughout the procedure. Unnecessary exchanges should be avoided, and resistance during catheter or sheath advancement should not be overcome with additional force. Radial spasm, dissection, and other access-related injuries can rapidly complicate an otherwise straightforward procedure. Similarly, radial access should not be pursued at all costs. Patient anatomy, target vessel location, required equipment, and the anticipated complexity of the intervention should all be considered when selecting the access route.

Finally, hemostasis should be considered part of the procedure rather than an afterthought. The objective is not simply to prevent bleeding but to achieve hemostasis while maintaining radial artery flow. Important strategies for preserving radial artery patency include patent hemostasis (confirmed with a reverse Barbeau test or pulse oximetry waveform during compression), avoidance of excessive compression, and minimized compression duration when feasible. In the PROPHET randomized trial, patent hemostasis reduced radial artery occlusion (RAO) by 59% at 24 hours and 75% at 30 days compared with conventional compression.[5] Similar principles have been incorporated into our interventional radiology practice and are reflected in the Society of Interventional Radiology quality improvement standards on radial artery access, where preservation of radial artery patency is increasingly important as patients undergo repeat procedures.[6]

Ultimately, successful radial access for complex embolization depends less on any individual device and more on a consistent procedural strategy. Careful patient and anatomic selection, ultrasound-guided access, appropriate pharmacology, thoughtful equipment selection, efficient and atraumatic catheter manipulation, and meticulous patent hemostasis allow radial access to be extended to increasingly complex interventions while maintaining a low complication rate.

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Vera Sharashidze, MD
Assistant Professor
Department of Neurosurgery, Neurology and Radiology
NYU Grossman School of Medicine
NYU Langone Health
New York, New York
vera.sharashidze@nyulangone.org
Disclosures: None.

TRA has expanded in my practice and many others from diagnostic angiography to increasingly complex neurointerventional procedures. Throughout this change, I have tried to maintain the same principles that made radial access so attractive in the beginning. As a rule, I use ultrasound guidance for radial access and make sure to always measure radial artery size when the case makes me anticipate that a larger-bore system will be needed. I use the smallest sheath and catheter system that will reliably accomplish the procedure, and I usually administer anticoagulation and antispasm medications. It is also crucial to use roadmap guidance when advancing your system. As we perform more complex interventions through the wrist, these precautionary measures will become more important because radial complications, although uncommon, include serious issues such as spasm, occlusion, perforation, hematoma, and pseudoaneurysm. In a series of 1,524 neuroendovascular procedures performed through radial access, local access complications occurred in 1.7%, with no deaths or permanent disability attributable to the radial approach.[1] Although small in total numbers, this is a sizeable source of risk.

The second important consideration in my experience is staying aware that radial access is not always the safest or most efficient route. Instead of being dogmatic and always favoring radial over femoral access, physicians need to select the best tool on a case-by-case basis. To do this, I carefully plan access based on the specific target vessel and the look of the arch and great vessel anatomy. As case complexity increases, I think it is particularly important not to equate successful radial practice with completing every procedure radially. If I anticipate the catheter to be unstable or judge the anatomy as unfavorable, I have a low threshold to change access strategy. I do not consider crossover to be a complication or technical failure; instead, I think in many cases it is good judgment. This view is supported by the neurointerventional practice: a systematic review of 1,342 radial neurointerventions found just 0.15%

major and 2.75% minor complications; however, a sizeable 4.8% of cases did require crossover. Most commonly, crossover was chosen because the target vessel could not be adequately catheterized.[2] More recent pooled data similarly demonstrate high procedural success with TRA, while confirming that crossover remains a necessary part of radial practice: In 12,927 patients, pooled procedural success was 95.9%, with a 3.5% complication rate and 4.9% crossover rate.[3]

Last but not least, I think maintaining radial patency after the procedure is also important. RAO is frequently asymptomatic, but it substantially complicates future access site, which is particularly relevant in neurointerventional patients who may require repeat procedures. I use patent hemostasis and avoid unnecessarily prolonged or excessive compression to minimize the risk of losing patency. Much of the evidence for prevention of RAO comes from the cardiology literature, with the randomized PROPHET trial demonstrating a 59% reduction in RAO at 24 hours and a 75% reduction at 30 days when radial patency was maintained during hemostatic compression.[4]

As we continue to extend radial access as standard procedure for flow diversion, thrombectomy, and other complex interventions, my goal is not to maximize the percentage of procedures performed through the wrist but to remain flexible in my approach. The best practice is to select radial access whenever it offers an advantage, use it efficiently, and exercise case-by-case judgment to preserve the low complication rate that drove its adoption in the first place.

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William E. Beckerman, MD, FSVS, FACS, RPVI
Associate Professor of Surgery
Medical Co-Director, RWJUH Center for Wound Healing
Program Director, Vascular Surgery Integrated Residency
Division of Vascular Surgery and Endovascular Therapy
Rutgers Robert Wood Johnson Medical School
New Brunswick, New Jersey
beckerwe@rwjms.rutgers.edu
Disclosures: None.

The utilization of TRA for noncoronary procedures has markedly increased over the last decade, as what began as systems cobbled together from cath lab equipment has exploded into a wealth of dedicated transradial peripheral product lines. TRA is now a vital part of the tool kit for the modern vascular surgeon and interventionalist, as increasingly complex procedures are now safely performed via 5-, 6-, and sometimes 7-F access. As we tackle these demanding cases, it is important to maintain the safety profile that is a significant advantage of TRA versus traditional transfemoral access.[1]

Safe access is, as always, paramount. Preoperative radial artery assessment—including evaluating the vessel diameter (typically > 2 mm), administering a Barbeau test, or both—will allow you to determine if the radial artery is safe for access. Ultrasound guidance to achieve a single-wall anterior puncture of the radial artery dramatically reduces the incidence of spasm, hematoma, and vessel transection. Prior to long sheath insertion, a tailored "radial cocktail," typically combining a calcium channel blocker (eg, 2.5-5 mg of verapamil or diltiazem) with intra-arterial nitroglycerin (100-200 µg) and weight-based heparinization (50-100 U/kg), should be administered directly through the initial access. This proactive spasmolytic regimen maintains vessel caliber, lowers shear stress during repeated catheter exchanges, and mitigates early RAO, which remains the primary technical pitfall of the approach.[2,3]

Navigating complex arch anatomies and targeting distal peripheral beds demands strategic sheath selection and active torque management. Transitioning to long, hydrophilic, sheaths or dedicated long, thin-walled TRA sheaths minimizes outer-diameter vessel stretching while providing the necessary guide support for downstream interventions. When traversing tortuous subclavian or arch anatomies, utilizing polymer-jacketed, 0.035-inch angled wires paired with soft-tipped diagnostic shaped catheters prevents wall dissection and catheter kink. Interventionalists must be aware of system length constraints, ensuring that long-shaft endovascular equipment (typically 180-200–cm shaft lengths for balloon-expandable stents, covered grafts, and atherectomy devices) is verified prior to crossing the aortic bifurcation or targeting infrapopliteal pathology.[4]

If you don't have a safe plan B (and plan C and D), you don't have a plan. If your TRA plan cannot deal with the potential complications of your procedure, whether due to limitations of bailout device profile, device shaft length, or device availability, either plan for additional potential access or avoid TRA altogether.

Experienced TRA operators know that safe sheath removal is as important as safe sheath insertion. Reintroduction of the TRA sheath dilator over a hydrophilic wire prior to removal will reduce the potential for kinking of the thin-walled sheath, which can compress into a razor-sharp edge if unsupported coming back through the arm. Implementing patent hemostasis protocols with dedicated pneumatic or mechanical compression bands ensures minimal occlusive pressure while preserving antegrade distal blood flow, which is verified via pulse oximetry or Doppler signal during compression. The radial band should be inflated just to the point of visual hemostasis, followed by a structured, time-delimited protocol for incremental deflation (typically commencing 60-90 minutes postprocedure). Avoiding overtightening and minimizing prolonged sheath dwelling times can drastically lower the risk of postprocedural RAO, pseudoaneurysm formation, and compartment syndrome, ensuring that the radial artery remains a reliable conduit for future interventions.[5] ■

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