

EDITORIAL COMMENT

Why Radial Access Is Better*



John A. Bittl, MD

The introduction of the transradial approach has raised vascular access to a level of refinement unforeseen by the pioneers of cardiac catheterization, who relied on direct left ventricular puncture or transbronchial left atrial catheterization to make hemodynamic measurements in the 1950s (1). With the advent of percutaneous coronary intervention (PCI) in the late 1970s, interventional cardiologists replaced brachial cut-downs with transfemoral access but remained troubled by an 8% rate of major bleeding or transfusion (2). In the 1990s, Campeau and Kiemeneij introduced radial access for PCI as a safer alternative to femoral approaches (3).

SEE PAGE 1419

In this issue of *JACC: Cardiovascular Interventions*, Ferrante et al. (4) present an updated meta-analysis of randomized controlled trials (RCTs) comparing transradial with transfemoral PCI. The investigators found that transradial PCI was associated with lower rates of vascular complications (odds ratio [OR]: 0.20; 95% confidence interval [CI]: 0.12 to 0.31), major bleeding (OR: 0.45; 95% CI: 0.28 to 0.62), and death (OR: 0.68; 95% CI: 0.49 to 0.90) than was transfemoral PCI in patients thought to be suitable for either approach for a broad range of clinical presentations.

The evidence in the present analysis favoring radial over femoral access seems solid but not unshakeable. Meta-analyses have been falling out of favor for several decades (5,6), but the present analysis (4) is notable for several strengths. First, the investigators scoured several trial repositories, such as ClinicalTrials.gov, to find published and

unpublished studies for their systematic overview. Second, the investigators went beyond the usual null-hypothesis statistical testing and calculated Bayes factors, which use small values to represent evidence both against the null hypothesis and for the alternative hypothesis (7). It would take a hitherto undiscovered randomized trial of more than 5,000 participants with a 2-fold higher mortality rate in the radial group (32 vs. 16) to change the Bayes factor for mortality to “not worth more than a bare mention” (8).

No sensitivity analysis eliminates the sobering fact that several excellent individual RCTs in the present overview (4) did not meet their prospectively defined primary endpoints to demonstrate superiority of transradial PCI (9,10). The difficulty in getting a “positive” result may have been explained by the small differences in event rates between transradial and transfemoral PCI. For every 1,000 patients undergoing transradial PCI instead of transfemoral PCI in the RCTs, Ferrante et al. (4) estimated that there were 10 fewer hemorrhages (95% CI: 7 to 12) and 6 fewer deaths (95% CI: 3 to 9).

Despite concerns, it is worthwhile to explore plausible explanations for the superiority of transradial PCI. Several anatomic features give the wrist an advantage over the groin. With the redundant vascular supply of the hand via the ulnar, median, and interosseous arterial branches, loss of a radial pulse has fewer consequences than loss of the common femoral artery pulse, which can be considered as the “left main” of the leg. Moreover, there are fewer potentially life-threatening vascular complications associated with radial access than with femoral access. Femoral closure-device infections are associated with 6% mortality (11) and retroperitoneal hematomas with 7% mortality (12).

To avoid femoral complications, practitioners need to know iliofemoral anatomy intimately, but after 50 years of experience, the understanding of femoral anatomy continues to generate misconceptions that

*Editorials published in *JACC: Cardiovascular Interventions* reflect the views of the authors and do not necessarily represent the views of the *JACC: Cardiovascular Interventions* or the American College of Cardiology.

From the Interventional Cardiology Section, Munroe Regional Medical Center, Ocala, Florida. Dr. Bittl has reported that he has no relationships relevant to the contents of this paper to disclose.

need correction (13). Selecting the right level for femoral access is critical, because a femoral stick a few millimeters too high and through the back wall of the artery violates the first principle of vascular access of avoiding puncture of noncompressible vessels. No debate about compressibility exists after puncture of the distal radial artery, which courses across the flat surfaces of the distal radius and the scaphoid bone, though the same cannot always be said for puncture of the distal ulnar artery, which courses over the semicircular surface of the distal ulna and the pyramidal surface of the triangular bone.

An additional reassuring finding in the present analysis (4) supporting the radial approach was the similar rate of stroke after transradial or transfemoral PCI (OR: 1.05; 95% CI: 0.70 to 1.59; $p = 0.80$), a finding that dispels concerns raised in a recently published subgroup analysis (14). Also, bleeding after transradial PCI may be less dependent on choice of anticoagulant agent than is bleeding after transfemoral PCI. Similar rates of bleeding were seen after bivalirudin or heparin in the transradial cohort of the MATRIX (Minimizing Adverse Hemorrhagic Events by Transradial Access Site and Systemic Implementation of Angiox) trial (OR: 0.63; 95% CI: 0.36 to 1.10; $p = 0.10$) (15) and in a group of RCTs in which transradial PCI was used in >50% of subjects (OR: 0.89; 95% CI: 0.57 to 1.41) (16).

In conclusion, the present report (4) provides moderately strong evidence that transradial PCI is slightly safer than transfemoral PCI. Although the introduction of radial access for PCI has been a major advance, this approach is not ideal for every procedure or every practitioner. There are many

senior interventional cardiologists who know femoral anatomy intimately, have performed tens of thousands of transfemoral PCIs safely, and get frustrated during transradial PCI by the occasional aortic arch that directs catheters into the descending aorta. For these operators, claims of better radial outcomes are reminiscent of the “emperor’s new clothes” (17), a fallacy that no one really believes but everyone is willing to accept because so many people keep saying that it is true.

Younger interventional cardiologists without extensive transfemoral experience may have a stronger prehensile feel for radial access than do older practitioners, but not every patient is a candidate for transradial PCI. Patients with unknown bypass graft anatomy, upper-extremity hemodialysis accesses, small radial arteries, abnormal Allen or oximetry test results, and need for large transfemoral devices or hemodynamic support are not favorable candidates for the transradial approach, but these groups represent a small proportion of patients undergoing PCI in contemporary practice.

In many centers outside the United States, transradial PCI has rapidly replaced transfemoral approaches (3). In the United States, transradial PCI will continue to gradually replace transfemoral approaches as older practitioners retire, but transradial PCI would replace transfemoral PCI more quickly if the radial approach could be reimbursed at a higher rate than the transfemoral approach.

REPRINT REQUESTS AND CORRESPONDENCE: Dr. John A. Bittl, Munroe Regional Medical Center, 1221 SE 5th Street, Ocala, Florida 34471. E-mail: jabittl@mac.com.

REFERENCES

- Lee TH. Eugene Braunwald and the Rise of Modern Medicine. Cambridge, MA: Harvard University Press, 2013.
- Doyle BJ, Rihal CS, Gastineau DA, Holmes DR Jr. Bleeding, blood transfusion, and increased mortality after percutaneous coronary intervention. Implications for contemporary practice. *J Am Coll Cardiol* 2009;53:2019-27.
- Rao SV, Cohen MG, Kandzari DE, Bertrand OF, Gilchrist IC. The transradial approach to percutaneous coronary intervention: historical perspective, current concepts, and future directions. *J Am Coll Cardiol* 2010;55:2187-95.
- Ferrante G, Rao SV, Jüni P, et al. Radial versus femoral access for coronary interventions across the entire spectrum of patients with coronary artery disease: a meta-analysis of randomized trials. *J Am Coll Cardiol Interv* 2016;9:1419-34.
- Bailor JC. The promise and problems of meta-analysis. *N Engl J Med* 1997;337:559-61.
- Institute of Medicine. Finding What Works in Health Care: Standards for Systematic Reviews. Washington, DC: National Academies Press, 2011.
- Spiegelhalter DJ, Abrams KR, Myles JP. Bayesian Approaches to Clinical Trials and Health Care Evaluations. Chichester, United Kingdom: Wiley, 2004.
- Jeffreys H. Theory of Probability. 3rd ed. Oxford, United Kingdom: Clarendon, 1961.
- Jolly SS, Yusuf S, Cairns J, et al. Radial Versus Femoral Access for Coronary Angiography and Intervention in Patients With Acute Coronary Syndromes (RIVAL): a randomised, parallel group, multicentre trial. *Lancet* 2011;377:1409-20.
- Rao SV, Hess CN, Barham B, et al. A registry-based randomized trial comparing radial and femoral approaches in women undergoing percutaneous coronary intervention: the SAFE-PCI for Women (Study of Access Site for Enhancement of PCI for Women) trial. *J Am Coll Cardiol Interv* 2014; 7:857-67.
- Sohail MR, Khan AH, Holmes DR Jr., Wilson WR, Steckelberg JM, Baddour LM. Infectious complications of percutaneous vascular closure devices. *Mayo Clin Proc* 2005; 80:1011-5.
- Kwok CS, Khan MA, Rao SV, et al. Access and non-access site bleeding after percutaneous coronary intervention and risk of subsequent mortality and major adverse cardiovascular events: systematic review and meta-analysis. *Circ Cardiovasc Interv* 2015;8:e001645.

13. Feldman R. Precise location of ideal common femoral artery puncture site. *J Am Coll Cardiol Intv* 2014;7:229.

14. Porto I, Bolognese L, Dudek D, et al. Impact of access site on bleeding and ischemic events in patients with non-ST-segment elevation myocardial infarction treated with prasugrel: the ACCOAST Access Substudy. *J Am Coll Cardiol Intv* 2016;9:897-907.

15. Valgimigli M, Frigoli E, Leonardi S, et al. Bivalirudin or unfractionated heparin in acute coronary syndromes. *N Engl J Med* 2015;373:997-1009.

16. Bittl JA, He Y, Lang CD, Dangas G. Factors affecting bleeding and stent thrombosis in clinical trials comparing bivalirudin with heparin during percutaneous coronary intervention. *Circ Cardiovasc Interv* 2015;8:e002789.

17. Andersen HC. The emperor's new clothes. In: Andersen's Fairy Tales. Garden City, NY: Nelson Doubleday, 1956:7-13.

KEY WORDS bleeding, meta-analysis, percutaneous coronary intervention, stent, transradial