Are Contemporary Femoral Approaches Comparable to Radial?

Experience and data on femoral access best practices and how they stack up against the radial approach.

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Radial access for percutaneous coronary intervention (PCI) is considered safe in terms of bleeding and vascular complications and is often substantially safer than femoral access according to published trials, registries, and meta-analyses.[1-3] Even in the United States, where the adoption of radial access has been slower than in other parts of the world, radial access appears to best femoral access with respect to bleeding and vascular complications. In 178,643 transradial PCIs performed in the United States between 2007 and 2012, bleeding complications occurred in only 2.67% of cases versus 6.08% of transfemoral cases ($P < .01$). Furthermore, vascular complications (defined as access site occlusion, peripheral embolization, arterial dissection, arterial pseudoaneurysm, or arteriovenous fistula) occurred in only 0.16% of cases versus 0.45% of transfemoral cases ($P < .01$).[4]

Although these accumulating data have made the utility of radial access as a bleeding avoidance strategy less controversial,[5] it remains unresolved how femoral access would fare in comparison with radial access with use of modern femoral best practices. Today, advances in arterial access, closure, and adjunctive pharmacology permit femoral access with a low rate of bleeding and vascular complications. In practice, uptake of these strategies is heterogeneous, and in major cited trials and registries, their use is typically incomplete or incompletely reported. We ask: putting its "best foot forward," would femoral access still come up short?

FROM ACCESS TO CLOSURE

A first advantage of radial access, facilitating accurate arterial puncture, is the conserved, superficial course of the radial artery in the lateral volar wrist. In comparison, a number of variables can complicate successful single anterior wall puncture of the common femoral artery via the traditional anatomic landmark and palpation-guided approach, including variations in both the femoral bifurcation and a patient's overlying anatomy. Errant puncture of the femoral vein, superficial or deep femoral artery, or external iliac artery can increase the risk of arteriovenous fistula, pseudoaneurysm, hematoma, or retroperitoneal hemorrhage. Larger sheath sizes, with larger associated arteriotomies, amplify these risks.

Current adjunctive techniques make it easier to achieve the coveted "perfect stick." These techniques include fluoroscopy guidance, ultrasound guidance, and micropuncture technique. Fluoroscopic guidance relies on the femoral head in the anteroposterior projection as a radiographic landmark for the level of the common femoral artery, with an ideal puncture described by Turi et al as being located 5 to 14 mm below the centerline of the femoral head.[6] Ultrasound guidance offers the added advantage of real-time visualization of the femoral artery itself, without added radiation exposure to patient and operator. Micropuncture technique, typically performed in conjunction with fluoroscopic guidance, entails initial puncture of the femoral artery with a 21-gauge (rather than an 18-gauge) needle, and cannulation with a smaller sheath, allowing confirmation of position by arteriography and, theoretically, mitigating consequences of an errant puncture.

In randomized studies, both fluoroscopy[7] and ultrasound guidance[8] have been associated with a reduction in "low" punctures. Whether routine application of either technique confers a reduction in major bleeding and vascular complications remains uncertain; it appears likely that these techniques are most effective when applied judiciously in selected cases with a challenging body habitus or high femoral bifurcation. An ongoing prospective trial (NCT02026180) will assess the impact of the micropuncture technique on vascular complications.

A second advantage of radial access, reducing the likelihood of access-site bleeding, is ease of closure. Compressive wristbands, such as the TR Band (Terumo Interventional Systems), reliably achieve arteriotomy closure by facilitating a patient's endogenous hemostatic system. The wristbands are simple to learn, comfortable for patients and opera-

tors, and safe, although excessive duration or intensity of compression has been linked with an increased risk of radial artery occlusion.[9,10] As such, compressive wristbands have become the standard of care for radial closure.

In contrast, femoral vascular closure devices have remained subject to greater controversy,[5] leaving manual compression as the gold standard. This controversy has stemmed in important part from experience with early femoral arteriotomy closure devices, which were associated with more vascular complications.[11] However, rates of vascular complications with newer closure devices, such as Angio-Seal (St. Jude Medical, Inc.) and Perclose (Abbott Vascular) do not appear to be higher.[11] The improved safety profile of these and other newer devices has rekindled interest in the role of femoral arteriotomy closure devices in not only improving patient and operator comfort but also in reducing bleeding.

TABLE 1. VASCULAR CLOSURE DEVICE AND BIVALIRUDIN USE IN PATIENTS RANDOMIZED TO FEMORAL ARTERIAL ACCESS IN RECENT TRIALS

Trial	Reference	Vascular Closure Device	Bivalirudin
RIVAL	Jolly et al 2011	25.6%	3.1%
RIFLE-STEACS	Romagnoli et al 2012	Unpublished	7.2%
STEMI-RADIAL	Bernat et al 2014	38%	0%

DATA REVIEW

Recent observational data from both large real-world registries[12,13] and post hoc analysis of randomized clinical trials[14,15] show an association between femoral vascular closure device use and less bleeding, particularly when combined with bivalirudin anticoagulation. In the largest of these studies, an analysis of 1,522,935 patients enrolled in the National Cardiovascular Data Registry (NCDR) CathPCI Registry who underwent PCI procedures between 2004 and 2008, bleeding events were observed in 2.8% of patients treated with manual compression, 2.1% of patients treated with vascular closure devices, 1.6% of patients receiving bivalirudin for anticoagulation, and 0.9% of patients treated with both vascular closure devices and bivalirudin ($P < .001$)—differences that remained significant in propensity-matched and site-controlled models.[13] A similar pattern has since been observed in the setting of PCI for acute coronary syndromes[14] and, most recently, primary PCI for ST-segment elevation myocardial infarction (STEMI).[15] In 11,621 patients undergoing coronary angiography with or without PCI in the ACUITY study, rates of major access-site bleeding were significantly lower with vascular closure device use versus manual compression (2.5% vs 3.3%; $P = .01$) and lowest in patients treated with both vascular closure devices and bivalirudin (0.7%).[14] Similarly, in 3,360 patients undergoing primary PCI via femoral access in the HORIZONS-AMI trial, the lowest rates of major bleeding unrelated to coronary artery bypass graft surgery were observed in patients treated with both vascular closure devices and bivalirudin.[15]

In addition to generating the hypothesis that combined vascular closure device use and bivalirudin anticoagulation may constitute a femoral best practice with respect to bleeding avoidance, data from these analyses also underscore the incomplete utilization of these strategies. In the NCDR CathPCI Registry,[13] only 42% of patients were treated with femoral vascular closure devices with (18%) or without (24%) bivalirudin. Vascular closure devices were used in only 37% of patients enrolled in the ACUITY trial[14] and in only 29% of eligible patients in HORIZONS-AMI.[15] Furthermore, in an apparent risk-treatment paradox, it seems that these strategies are used least in the patients who might benefit from them most. Despite exhibiting significantly lower rates of bleeding when vascular closure devices (4.6%), bivalirudin anticoagulation (3.8%), or both (2.3%) were used (vs 6.1% with manual compression), patients at the highest risk for bleeding were also the least likely to receive either treatment.[13] As is unavoidable in such nonrandomized comparisons, confounding by patient comorbidities invariably influences these observed differences in bleeding outcomes. Causality cannot be inferred. These provocative findings nonetheless identify a need for a large-scale, prospective randomized trial to evaluate the combined impact of vascular closure devices and bivalirudin on bleeding outcomes of PCI.

If newer access techniques, vascular closure devices, and bivalirudin anticoagulation do in fact improve the safety of transfemoral PCI, we are left to ask: at its best, how might femoral access compare with radial access? The most recent head-to-head trials of radial versus femoral access, focused on PCI for acute coronary syndromes and STEMI, still leave us wanting for answers. In the largest recent trial, the RIVAL study, which randomized 7,021 patients with acute coronary syndromes to radial or femoral access, rates of major bleeding unrelated to coronary artery bypass graft surgery were arithmetically lower at 30 days with use of radial access, but with a low bleeding event rate, this difference was not statistically significant (0.7% vs 0.9%; $P = .23$).[16] Major bleeding was significantly lower with radial access in the RIFLE-STEACS trial, which enrolled 1,001 patients with STEMI (7.8% vs 12.2%; $P = .026$).[17] Major bleeding and vascular complications were also lower with radial access in the most recently published STEMI-RADIAL trial, which enrolled 707 patients with STEMI.[18] It is critical to observe, however, that in each of these trials, utilization of vascular closure devices and bivalirudin anticoagulation was sparse (Table 1), and techniques for femoral arterial access were undocumented and left to operator discretion.

It is possible that bleeding and vascular complications with femoral access would be similar to those observed with radial access if best practices were used. Absent a dedicated trial to address this question, our knowledge is limited to that derived from indirect, nonrandomized comparisons. In this manner, it is remarkable that, in HORIZONS-AMI, 30-day rates of major bleeding unrelated to coronary artery bypass graft surgery were similar with radial access (3.5%)[19] and with femoral access coupled with combined vascular closure device and bivalirudin use (3.8%).[15] We look forward to results of the ARISE trial (NCT01653587), which will directly compare bleeding and vascular complications in patients with non-STEMI randomized to radial access or femoral access with a vascular closure device.[20]

When bleeding and vascular complications are compared between the two approaches, it will be essential to weigh not only the quantity but also the quality of these complications. Reductions in bleeding associated with radial access are largely driven by lower rates of access site bleeding. In a meta-analysis of 5,055 patients in 12 trials of STEMI, radial access was associated with a substantially lower rate of access site bleeding (2.1% vs 5.6%; OR, 0.35; 95% CI 0.25-0.50; $P < .001$).[3] But we know from analysis of HORIZONS-AMI[21] and a separate pooled patient-level analysis of 14,180 patients in seven trials[22] that access site and nonaccess site bleeding are unequal in their implications for patient outcomes: nonaccess site bleeding carries a substantially higher risk of 1-year mortality. To understand this observation, it is helpful to recognize that the vast majority of access site bleeds are not devastating retroperitoneal hemorrhages (0.15% to 0.44% of cases) but rather large hematomas.[23] In RIVAL, hematomas were substantially more common than major bleeding, and less frequent with radial access.[16] Although isolated hematomas may contribute to patient discomfort, delays to mobilization and hospital discharge, and increased costs, in multiple analyses, such large hematomas have had no independent association with mortality.[24,25]

CONCLUSION

In 2014, there is little dispute that radial access is an effective strategy for achieving low rates of access site bleeding and vascular complications during PCI. Before discarding femoral access, however, it is important to recognize that certain "best practices" may permit transfemoral PCI to achieve rates of bleeding and vascular complications that truly rival those of the radial approach. ■

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