

# The Radial Approach for STEMI

Could this become the new standard of care?

BY ROBERT J. APPEGATE, MD

Establishing the superiority of reperfusion therapy for the treatment of acute ST-elevation myocardial infarction (STEMI) ushered in a new era in contemporary cardiology. Although reperfusion was initially achieved with thrombolytic therapy, limitations and bleeding complications with this approach gave way to the use of primary percutaneous coronary intervention (PCI) as the new standard in care.<sup>1,2</sup> As evidence mounted that primary PCI for STEMI was superior to thrombolytic therapy, and a clear mandate was established for primary PCI as the preferred strategy for treatment, the need to provide this service in a timely fashion to the vast majority of patients with STEMI became a pressing national health initiative. A door-to-balloon time (D2B) < 90 minutes was established as the goal for providing primary PCI to patients with STEMI and was incorporated as an important metric for the care of these patients. As systems of care adapted to accommodate D2B treatment within 90 minutes, the percentage of patients able to be treated within this time frame increased from approximately 10% to more than 90% in the most recent evaluation of this metric.<sup>3-5</sup>

The cardiac catheterization and interventional approach adopted for use of primary PCI was similar to that used for elective cases. This approach included femoral artery access in the vast majority of patients undergoing this procedure. Decades of experience and comfort with the femoral approach facilitated the continued adoption of this technique for primary PCI for STEMI, despite clinical trial and registry data indicating that the femoral access site bleeding complications associated with emergency procedures, such as STEMI, were higher than in elective cases.<sup>6,7</sup>

## ACCESS SITES

Although the femoral artery approach for routine catheterization and intervention has become the stan-

dard of practice, alternative access sites including the brachial and radial arteries have been around for several decades. The brachial approach was first introduced by Sones<sup>8</sup> in the 1950s, using a cutdown technique, but it was abandoned with the introduction of the femoral approach using sheaths and preformed catheters.<sup>7,9</sup> Additionally, complications associated with the brachial artery approach were comparable to or exceeded that of procedures performed from the femoral artery.<sup>10</sup>

The radial artery approach was introduced several decades ago but received little uptake, particularly in the United States, because of issues including spasm, variations in the pathway from the wrist to the ascending aorta, limitations in catheter sizes, and less-than-optimal equipment specific to the radial approach.<sup>11,12</sup> However, during the past decade, improvements in

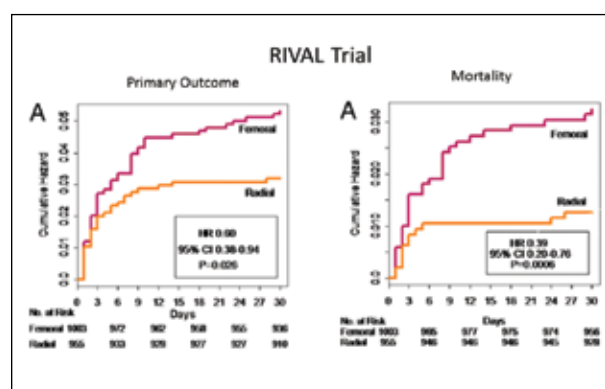


Figure 1. Kaplan-Meier plots of the primary outcome (death, myocardial infarction, stroke, or non-CABG bleeding at 30 days) (A) and mortality (B) from the RIVAL trial. Reprinted from the *Journal of the American College of Cardiology*, 60, Mehta SR, Jolly SS, Cairns J, et al, Effects of radial versus femoral artery access in patients with acute coronary syndromes with or without ST-segment elevation, 2490–2499, Copyright (2012), with permission from Elsevier.<sup>13</sup>

technique and technology, as well as a growing emphasis on safety during catheterization and interventional procedures, have seen a tremendous upsurge in the use of the radial approach.<sup>14</sup>

## RECENT DATA

Several recent trials and meta-analyses have examined the safety and efficacy of cardiac catheterization and intervention performed via radial or femoral access.<sup>15-17</sup> Together, these studies confirm that the rates of access site vascular complications associated with radial procedures are lower than those performed from femoral access. Additionally, they identified that overall bleeding was lower with procedures performed via radial access. Based on the results of these studies and educational initiatives concerning the relative safety of the radial approach, there has been an increase in the utilization of the radial approach for routine diagnostic catheterization and interventional procedures within the United States.

With the growing awareness of the importance of bleeding reduction strategies to improve the outcomes of patients undergoing coronary interventions<sup>6,7</sup> and the reduction in access site complications associated with use of the radial approach compared to the femoral approach, there has been an increasing interest in the use of the radial artery approach for primary PCI for STEMI. Several small randomized trials and registries have evaluated the clinical outcomes, as well as the procedural metrics, associated with the use of the radial approach compared to the femoral approach in patients with STEMI.<sup>18-21</sup> There has been a consistent observation of decreased vascular complication rates associated with the use of the radial approach as opposed to the femoral approach. Additionally, in many of these studies, there was also a decrease in overall rates of bleeding, as well as mortality.<sup>19</sup>

The RIVAL trial evaluated 7,021 acute coronary syndrome patients randomized to either radial or femoral

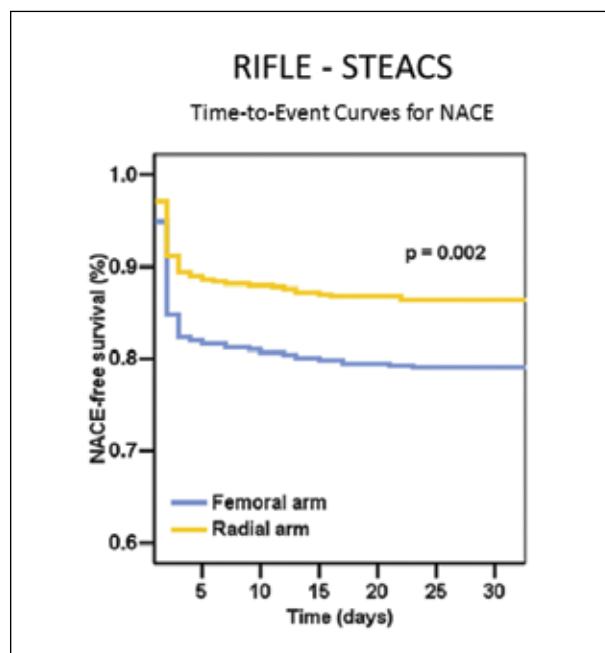


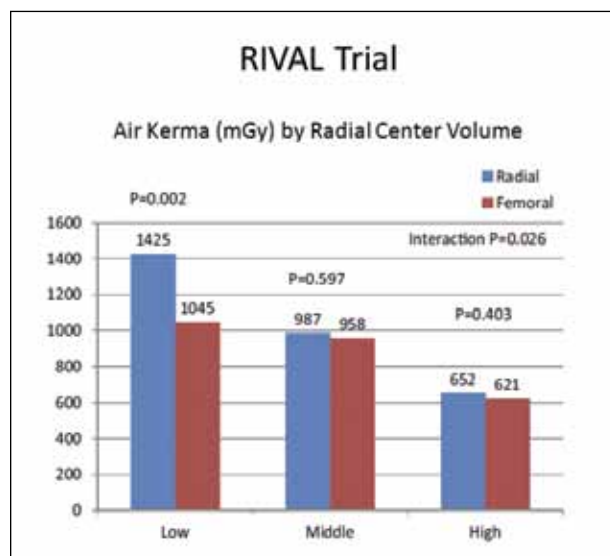
Figure 2. Kaplan-Meier plots of time to event for net adverse clinical events (cardiac death, stroke, myocardial infarction, target lesion revascularization, and bleeding) from the RIFLE-STEACS trial. Reprinted from the Journal of the American College of Cardiology, 60, Romagnoli E, Biondi-Zoccai G, Sciahbasi A, et al, Radial versus femoral randomized investigation in ST-segment elevation acute coronary syndrome: the RIFLE-STEACS (Radial Versus Femoral Randomized Investigation in ST-Elevation Acute Coronary Syndrome) study, 2481–2489, Copyright (2012), with permission from Elsevier.<sup>22</sup>

access. A significant reduction in the rates of major vascular access complications from 3.7% to 1.4% was observed with the use of radial compared to femoral access, but no substantial differences in the overall rates of bleeding nor mortality were found.<sup>23</sup>

TABLE 1. RIFLE-STEACS LESION AND PROCEDURAL CHARACTERISTICS<sup>a</sup>

| Procedural Characteristics           | Overall (N = 1,001) | Femoral (n = 501) | Radial (n = 500) | P Value |
|--------------------------------------|---------------------|-------------------|------------------|---------|
| Symptom-to-balloon time, min         | 207 (140–380)       | 198 (135–392)     | 214 (145–375)    | .29     |
| Door-to-balloon time, min            | 56 (34–95)          | 53 (31–91)        | 60 (35–99)       | .175    |
| Artery puncture-to-balloon time, min | 10 (8–17)           | 10 (8–15)         | 10 (8–20)        | .035    |

<sup>a</sup>Adapted from the Journal of the American College of Cardiology, 60, Romagnoli E, Biondi-Zoccai G, Sciahbasi A, et al, Radial versus femoral randomized investigation in ST-segment elevation acute coronary syndrome: The RIFLE-STEACS (Radial Versus Femoral Randomized Investigation in ST-Elevation Acute Coronary Syndrome) study, 2481–2489, Copyright (2012), with permission from Elsevier.<sup>22</sup>



**Figure 3.** Bar graph of air kerma (mGy) with radial or femoral access stratified by radial center volume. Reprinted from the *Journal of the American College of Cardiology*, 61, Jolly SS, Cairns J, Niemela K, et al, Effect of radial versus femoral access on radiation dose and the importance of procedural volume: a substudy of the multicenter randomized RIVAL trial, 258–266, Copyright (2013), with permission from Elsevier.<sup>24</sup>

In the RIFLE-STEACS trial, which compared outcomes in STEMI patients randomized to either radial or femoral access, similar observations were made.<sup>22</sup> Interestingly, in the subgroup of STEMI patients in the RIVAL trial

(Figure 1),<sup>13</sup> as well as in the MORTAL trial<sup>15</sup> and the RIFLE-STEAC trial (Figure 2),<sup>22</sup> there was also a significant reduction in mortality with the radial approach as opposed to the femoral approach. Although these studies were not designed to address specific mechanisms, one presumes that this is related to a decrease in the access site and bleeding complications associated with the radial approach. It may have also been related to more liberal use of antithrombotic agents. Further data are required to provide convincing evidence that the radial artery approach reduces mortality in STEMI patients beyond these observations obtained to date, but these consistent observations provide strong support for a radial rather than a femoral approach for primary PCI for STEMI.<sup>25</sup>

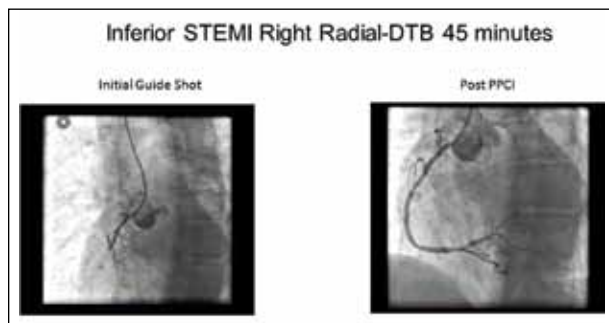
With respect to the procedural metrics associated with a radial approach for primary PCI for STEMI, there has been concern that the radial approach will make adherence to a 90-minute D2B time metric problematic. However, in spite of a widely held perception in the United States that radial primary PCI for STEMI takes “a lot longer,” the existing data suggest that the increase in time associated with the radial approach is small and does not preclude performing routine STEMI cases with a D2B < 90 minutes.<sup>17,23</sup> In the RIFLE-STEACS trial, D2B times were 60 minutes (range, 31–91) for radial and 53 minutes (range, 35–99) for femoral ( $P = .175$ ) (Table 1). Thus, there was a small, nonsignificant increase in D2B time with the radial approach, but D2B times well under 90 minutes were still more often achieved with the radial approach.

**TABLE 2. RIVAL TRIAL MEDIAN FLUOROSCOPY TIMES WITH RADIAL VERSUS FEMORAL ACCESS<sup>a</sup>**

|                               | Radial (Min)    | Femoral (Min) | P Value | Interaction P Value <sup>b</sup> |
|-------------------------------|-----------------|---------------|---------|----------------------------------|
| Overall (N = 5,740)           | 9.3 (5.8–15)    | 8 (4.5–13)    | < .001  |                                  |
| <b>Radial center volume</b>   |                 |               |         |                                  |
| Low (n = 1,551)               | 10 (6.7–16)     | 8.5 (5–13)    | < .001  | .021                             |
| Middle (n = 2,331)            | 9.5 (5.1–15)    | 7.8 (4–13)    | < .001  |                                  |
| High (n = 1,858)              | 8.3 (5–13.4)    | 8 (5–13)      | .059    |                                  |
| <b>Radial operator volume</b> |                 |               |         |                                  |
| Low (n = 1,814)               | 10.9 (6.7–16.4) | 8.2 (5–13)    | < .001  | .002                             |
| Middle (n = 1,946)            | 9 (5–14.1)      | 7.3 (4–12.8)  | < .001  |                                  |
| Low (n = 1,975)               | 8.7 (5.3–14)    | 8 (5–13.1)    | .024    |                                  |

<sup>a</sup>Adapted from the *Journal of the American College of Cardiology*, 61, Jolly SS, Cairns J, Niemela K, et al, Effect of radial versus femoral access on radiation dose and the importance of procedural volume: a substudy of the multicenter randomized RIVAL trial, 258–266, Copyright (2013), with permission from Elsevier.<sup>24</sup>

<sup>b</sup>Interaction above and below the median.

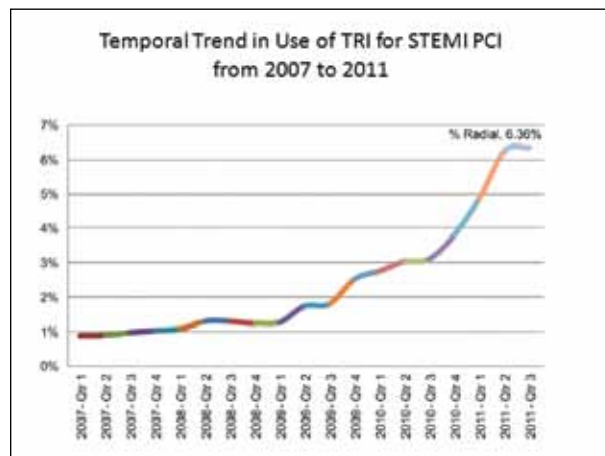


**Figure 4.** Still-frame images of the initial guide shot during catheterization for primary PCI for STEMI (A) and a still-frame image of the result after percutaneous transluminal coronary angioplasty and stenting of the right coronary artery (B).

There has been debate among interventionists that the radial approach may not only threaten their ability to achieve D2B times < 90 minutes, but that it may limit their options in complex cases. For example, the preference to place two stents simultaneously, such as with the “crush” procedure, requires a 7-F or larger guide, which is not usually used during radial interventions. However, a sheathless technique has been developed from the radial artery that allows the use of a 7-F guide (which has the same outer diameter as a 6-F sheath) should this be needed.<sup>26-28</sup>

Also, STEMI in patients with previous coronary artery bypass grafting is viewed as problematic and challenging from the radial artery. However, in such cases, the procedure can be completed from the left radial artery with the same technique as from the femoral artery and offers much easier access to the left internal mammary artery, should that be essential to the case. Finally, patients with shock complicating a STEMI are viewed as extreme challenges when attempted from the radial artery. The major challenge in shock cases is access itself, as it is challenging to achieve access in the absence of a palpable pulse. In such cases, we move to the femoral artery, but if a radial pulse is present, we proceed with radial access using the femoral artery for support devices, as needed.<sup>25,29</sup>

There have also been concerns that use of radial access is associated with slightly longer procedure times, as well as a slight increase in the use of fluoroscopy and radiation exposure to operators for both routine and urgent cases, such as primary PCI for STEMI.<sup>30,31</sup> These perceived barriers to increased utilization of a preferred radial strategy have been addressed in part by a post hoc analysis of the RIVAL trial.<sup>24</sup> Median fluoroscopy times for femoral and radial cases



**Figure 5.** Time-incidence plot of the temporal trend in the use of transradial interventions for STEMI in the United States from 2007–2011. Reprinted from the *Journal of the American College of Cardiology*, 61, Baklanov DV, Kaltenbach LA, Marso SP, et al, The prevalence and outcomes of transradial percutaneous coronary intervention for ST-segment elevation myocardial infarction: analysis from the National Cardiovascular Data Registry (2007 to 2011), 420–426, Copyright (2013), with permission from Elsevier.<sup>5</sup>

are shown in Table 2. Overall, fluoroscopy times were slightly longer for radial procedures than for femoral procedures (9.3 minutes [range, 5.8–15] vs 8 minutes [range, 4.5–13], respectively;  $P < .01$ ), but these differences were substantially mitigated by high-volume operators and centers. Similarly, air kerma was slightly higher for radial compared to femoral cases, but the difference was seen almost exclusively among low-volume centers (Figure 3). These data strongly support the concept that experience can eliminate differences in procedure time and radiation exposure between these two approaches, while preserving the safety benefit of radial versus femoral access.

At Wake Forest Baptist Medical Center, we now use the radial artery as the preferred access site for STEMI cases. The decision to adopt radial as the preferred access for STEMI was part of an overall initiative in the cath lab to transition from the femoral artery as the preferred access site to the radial artery as the preferred access for diagnostic catheterization and coronary interventions.<sup>32</sup> This decision was based on a strong consensus among the interventionists that radial artery access offered the safest approach for these procedures and that its adoption would represent an improvement in the overall quality and experience of the procedure for the patients. This process was facilitated by innova-

tions in sheath and catheter design, as well as the benefit of the entire lab and staff transitioning to a preferred radial approach. This latter strategy helped shorten the learning curve for staff and physicians and provided consistency in case-to-case and day-to-day setup and organization.

We developed a staged approach to the implementation of a preferred radial approach with simple diagnostic cases first, followed by graft cases, and then coronary interventions. We deferred transitioning to a preferred radial strategy for STEMI until everyone was confident that access, diagnostic imaging, and the intervention itself could be performed without concern for delay in achieving D2B times < 90 minutes. Figure 4 shows an example from our center when the radial approach was used for PCI of an inferior STEMI caused by a mid-right coronary artery occlusion. The D2B time was 45 minutes, with prompt clinical reperfusion. For well over a year now, the radial approach has been the preferred strategy for STEMI at Wake Forest, with D2B times comparable to that previously achieved using femoral artery access.

## CONCLUSION

For interventionists who use the radial approach as their preferred strategy for diagnostic catheterization and interventions, the use of this approach for STEMI is a natural extension of their preferred practice strategy. For interventionists who do not use the radial approach for diagnostic catheterization and intervention procedures, is it time for them to reconsider their access choice? For interventionists outside of the United States, the answer has been a resounding “yes.”<sup>33</sup> Within the United States, a minority of primary PCI for STEMI cases are performed radially, but there is growing adoption of the radial approach as the preferred strategy for all cases, including STEMI, based on the recognition of the safety of the procedure, as well as the ability to achieve times < 90 minutes comparable to that achieved using the femoral approach (Figure 5).<sup>5</sup> Given the growing success of the radial approach in routine PCI cases in this country, its improved safety, and its potential mortality benefit compared to the femoral approach, it is time for the interventional community to accept radial primary PCI as the standard of care in STEMI cases. ■

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