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Systematic Use of Transradial PCI in Patients With ST-Segment Elevation Myocardial Infarction

A Call to "Arms"

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A growing body of evidence now supports the use of transradial percutaneous intervention (TRI) as the preferred access site for the treatment of patients with ST-segment elevation myocardial infarction (STEMI). Historically, TRI has been avoided in the STEMI population due to concerns over longer procedure time, longer door-to-device time, higher crossover rates, and the experience level required with TRI compared with transfemoral access. However, in recent years, recognition of the impact of periprocedural bleeding on mortality in patients with acute coronary syndromes has garnered interest in the utility of TRI as an established method to reduce bleeding. Registry data, meta-analyses, and randomized control trials all similarly demonstrate that TRI is associated with reduced periprocedural bleeding and lower mortality compared with transfemoral access in the STEMI population. Additional benefits of TRI include enhanced patient comfort, reduced hospital length of stay, and reduced cost. Despite the evidence, trends in use of TRI in the United States have shown a slow adoption rate as a result of multiple barriers in clinical practice and doubts about the mechanism and causal relationship of mortality reduction with TRI. We summarize the current evidence and propose a call to action to foster training of TRI in cardiovascular fellowship programs and post-fellowship courses, and for more widespread implementation of TRI in STEMI patients. (J Am Coll Cardiol Intv 2013;6:1145–8) © 2013 by the American College of Cardiology Foundation

There is nothing permanent but change.
—Heraclitus (1)

Periprocedural bleeding in patients with myocardial infarction who undergo percutaneous coronary intervention (PCI) is strongly associated with increased mortality (2). Despite improvements in antiplatelet agents, anticoagulation strategies, and smaller sheath size, access-site bleeding remains the single most common cause of periprocedural hemorrhage. The transradial approach is now a well-established method to reduce periprocedural bleeding. Although recent data show a trend of increasing use of transradial percutaneous intervention (TRI) for ST-segment elevation myocardial infarction (STEMI), the vast majority of hospitals in the United States perform <1% TRI for STEMI (3). In comparison, European rates are vastly higher, ranging from 50% to 80% in some countries (4,5). The reasons for this are unclear.

Potential Mechanisms for Improved Outcomes With TRI

A pooled analysis of 4 trials showed that periprocedural bleeding doubles the odds of mortality in patients undergoing PCI (2). The exact mechanism by which bleeding leads to higher mortality remains elusive but is likely multifactorial. Bleeding often prompts discontinuation of antithrombotic and antiplatelet therapy, sometimes before surgical or other interventional procedures, potentially increasing the risk of stent thrombosis (6,7). Bleeding activates platelets and the clotting cascade to achieve hemostasis, a response that may

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be overamplified in patients with endothelial dysfunction and acute coronary syndromes. Erythropoietin, released in response to anemia, activates platelets and plasminogen activator inhibitor-1, which also may promote a prothrombotic state (8).

Evidence for Reduced Bleeding and Mortality With TRI

A growing body of literature, including systematic reviews and meta-analyses, 2 large randomized control trials, and registry data, suggests that TRI for STEMI significantly reduces bleeding and mortality (Table 1) (3,9–12).

Registry data. A recent National Cardiovascular Data Registry analysis from 2007 to 2011 showed that TRI was associated with slightly longer median door-to-balloon times (78 vs. 74 min; $p < 0.0001$), but a 38% relative reduction in the adjusted risk of bleeding and a 24% relative reduction in in-hospital mortality (3). Observational data from Scotland (5) showed reduced 30-day and 1-year mortality with TRI compared with the transfemoral (TF) approach in STEMI patients treated with both primary PCI and rescue PCI. Unpublished data from the Swedish Coronary Angiography and Angioplasty Registry suggest a similar survival benefit with TRI for STEMI (13). Finally, a recent retrospective analysis of patients with STEMI and cardiogenic shock at 2 high-volume radial PCI centers showed that TRI was feasible in 50% of patients and was associated with improved 1-year survival compared with the TF approach (44% vs. 64%, $p = 0.004$) (14). Registry data, of course, can be limited by selection and referral biases. Although registry data were analyzed using propensity score matching, comparing 2 different treatment modalities using observational evidence has inherent limitations because unmeasured variables may have influenced which treatment they received.

Abbreviations and Acronyms

PCI = percutaneous coronary intervention

RRR = relative risk reduction

STEMI = ST-segment elevation myocardial infarction

TF = transfemoral

TRI = transradial percutaneous intervention

Meta-analyses. A meta-analysis of 8 randomized control trials and 13 retrospective studies comparing TRI with the TF approach in 8,534 STEMI patients showed marked reductions in major adverse cardiac events (44% relative risk reduction [RRR]), mortality (45% RRR), and major bleeding (68% RRR) compared with TF (9). Another meta-analysis of 10 randomized controlled trials (3,347 patients) showed that TRI was associated with improved survival and reduced vascular complications/hematoma, whereas a nonsignificant trend toward reduced major bleeding with TRI was found (12).

Randomized trials. The pre-specified STEMI subgroup of the RIVAL (Radial Versus Femoral Access for Coronary Intervention) trial showed that TRI was associated with reduced mortality and fewer vascular and ACUITY (Acute Catheterization and Urgent Intervention Triage Strategy)-defined bleeding (major bleeding that included large hematomas and pseudoaneurysm) complications (10). By contrast, among the non-ST-segment elevation myocardial infarction (NSTEMI) subgroup, there were no significant differences in primary or secondary outcomes between TRI and TF, but ACUITY-defined bleeding and vascular complications were lower. The RIFLE-STEACS (Radial Versus Femoral Randomized Investigation in ST-Elevation Acute Coronary Syndrome) trial randomized 1,001 STEMI patients to TRI or TF at 4 centers in Europe (11). The primary endpoint of 30-day net adverse cardiovascular events occurred in 13.6% in TRI and 21.0% in TF ($p = 0.003$), with TRI being associated with lower rates of cardiac mortality (5.2% vs. 9.2%, $p = 0.02$) and bleeding (7.8% vs. 12.2%, $p = 0.03$), and shorter hospital stay (5 vs. 6 days, $p = 0.008$). Importantly, all participating interventional cardiologists in the RIFLE-STEACS study were high-volume operators (≥150 PCIs/year) and had expertise in both approaches, meeting the minimal proficiency criterion of 50% TRIs per year.

Study limitations. Although the RIFLE-ACS study was a multicenter randomized trial, it included only 4 centers,

Table 1. Recent Studies Demonstrating Reduced Bleeding and Mortality With TRI for STEMI

First Author (Ref. #)	Year	Study Type	Sample Size	Bleeding ORs TR vs. TF	Mortality ORs TR vs. TF	NNT to Prevent 1 Bleeding Event	NNT to Prevent 1 Death
Mehta et al. (10)	2012	Multicenter RCT; STEMI subgroup	1,958	0.49 (0.28–0.84)	0.39 (0.20–0.76)	48	52
Romagnoli et al. (11)	2012	Multicenter RCT	1,001	0.64 (0.44–0.94)	0.57 (0.36–0.90)	23	25
Jang et al. (9)	2012	Meta-analysis of 21 studies	8,534	0.32 (0.22–0.48)	0.55 (0.42–0.72)	65	53
Joyal et al. (12)	2012	Meta-analysis of 10 RCTs	3,347	0.63 (0.35–1.12)	0.53 (0.33–0.84)	NA	61
Baklanov et al. (3)	2013	Observational	90,879	0.62 (0.53–0.72)	0.76 (0.57–0.99)	25	207

Values are n or odds ratios (OR) and 95% confidence intervals.
NA = not available; NNT = number needed to treat; RCT = randomized control trial; STEMI = ST-segment elevation myocardial infarction; TF = transfemoral; TR = transradial; TRI = transradial percutaneous intervention.

with operators required to be high volume. Use of bivalirudin, a pharmacological intervention known to reduce bleeding, was infrequent in both treatment groups. Legitimate concerns over the RIVAL trial results include the fact that the STEMI analysis was a pre-specified subgroup. Additionally, the study was primarily powered for combined NSTEMI and STEMI groups, in which the primary and key secondary endpoints were similar between the TRI and TF approaches. Finally, both the RIFLE-ACS and RIVAL trials were underpowered for mortality, and some remain skeptical of the large treatment effect size with TRI, arguing that a larger trial is needed.

Considering the Tradeoffs

Minimally longer procedural times (from 2 to 4 min in duration), longer fluoroscopy duration, and higher crossover rates have been shown with TRI (4% to 6%) versus TF PCI (3%) for STEMI. Because experienced operators were the majority in randomized trials, there is concern that procedural delays may be longer for new radial operators confronted with tortuous arm vascular anatomy and the need to rapidly engage coronary arteries. Our own experience suggests that the crossover delay is usually $\leq$5 min, can be limited by the clock, and is unlikely to have any clinical impact in the vast majority of patients. Ninety percent to 95% of patients will have successful TRI for STEMI, and crossover rates diminish with increasing operator experience, according to data from the REAL (REgistro regionale AngiopLastiche dell'Emilia-Romagna) registry (15). The available evidence points toward a survival benefit with TRI, perhaps because the incremental delay in door-to-device time is outweighed by benefit derived from reduced access site–related bleeding. Furthermore, TRI does not preclude placement of an intra-aortic balloon pump via the femoral artery at any stage of the procedure and avoids the need for bilateral femoral instrumentation in many patients. Femoral access sites can be prepped and draped in TRI procedures as back-up. Important additional benefits from the patient's standpoint (i.e., the most important standpoint) of TRI include improved procedural comfort, earlier ambulation, and reduced length of stay (16). A recent Premier research database analysis confirmed that TRI was also associated with reduced hospital costs and shorter length of stay compared with TF-access PCI (17).

A Call to Action: What Are We Waiting For?

The wealth of evidence supporting widespread use of TRI for patients with STEMI, and possibly extension to NSTEMI, has important implications for interventional cardiology training programs. Current and future trainees need to be comfortable with TRI and thus will require that their teachers are also comfortable with this approach. Although it may be difficult to convince high-volume operators who are very skilled in the TF approach to adopt the radial approach, our own experience suggests that they master radial skills quickly.

Conclusions

Available evidence indicates that TRI is the optimal treatment approach for patients presenting with STEMI due to reduced bleeding and mortality. Accordingly, there is a clear need for trainees and interventional cardiologists in practice to master transradial skills in order to implement this important treatment strategy.

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Key Words: PCI ■ STEMI ■ transradial.