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Size Matters: Moving Toward a Slender Transradial Artery Approach

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Over the last decade, data have shown that a transradial artery (TRA) approach reduces access-site complications when compared to a transfemoral artery (TFA) approach, as well as being associated with lower rates of bleeding, acute kidney injury, and all-cause mortality in high-risk patients, particularly in the setting of acute coronary syndrome (ACS) [1, 2]. In fact, the European guidelines have defined TRA as a preferred approach over TFA in ACS [3].

However, TRA is not without any complications. Radial artery occlusion, though largely asymptomatic, may preclude the use of TRA for subsequent procedures. Radial artery occlusion is more likely to occur in the setting of higher relative vascular sheath size and degree of artery to catheter diameter mismatch, in addition to non-patent hemostasis, older age, female sex, and lower body mass [4]. Furthermore, similar to TFA, access site complications associated with TRA increase with the size of introducer used [5]. A 6 French (Fr) catheter may be too large for the radial arteries of patients with lower body mass index or body surface area, and may result in pain and significant spasm. Female patients often fit these characteristics associated with smaller radial artery diameters and, more often than not, will have an inner radial artery diameter smaller than the outer diameter of a 6 Fr introducer [6]. Multiple studies have also defined female sex, in addition to older age, short height, and hypertension, as predictors of failure to complete a procedure via TRA [7–9].

An international survey demonstrated that 46% of TRA operators use a 6 Fr sheath, while 42% use a 5 Fr sheath and 12% use a 4 Fr sheath for diagnostic coronary angiography [10]. For percutaneous coronary intervention (PCI) procedures, however, more than 60% of TRA operators use a 6 Fr guide catheter in a 6 Fr compatible introducer [10]. Whether or not TRA operators tailor their approach to patient characteristics, however, remains uncertain. Furthermore, few studies have evaluated the use of TRA in these high-risk patient populations. SAFE-PCI, a registry-based randomized trial comparing TRA and TFA in women, showed that among women undergoing cardiac catheterization or PCI, TRA significantly reduced bleeding and vascular complications (0.6% vs. 1.7%; OR: 0.32; 95% CI: 0.12 to 0.90). However, access site crossover was significantly higher among women assigned to TRA when PCI was indicated. Despite the crossover rate, though, the preferred access among the studied population was TRA [11]. Whether left versus right TRA should

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be used in patients with features of high-risk TRA failure is another important component of the equation. Our group performed a single-center randomized trial to evaluate the effect of arterial access site (left vs. right TRA) on radiation parameters in patients with predictors of TRA failure (3 of 4 following criteria: age ≥ 70 years, female sex, height ≥ 64 inches, hypertension). In this study, more than 90% of patients enrolled were women with short stature, and parameters of radiation were numerically but not statistically lower with the use of left TRA [12]. No conclusive data, though, are available on the optimal Fr size in these patients at high risk of failure to complete procedures via TRA. If on one hand, some operators prefer a 5 Fr system to minimize the risk of spasm and increase the likelihood of overcoming peripheral tortuosity, 6 Fr systems are widely used for the use of a larger selection of devices and techniques during PCI.

In this issue of *Cardiovascular Revascularization Medicine*, Sgueglia et al. present a single-center, prospective observational study [13] evaluating two different approaches to TRA in short-stature women (<160 cm height): A full 6 Fr workflow (6 Fr introducer sheath, diagnostic catheters, and guiding catheter) versus a modified workflow that uses a 6 Fr introducer sheath, 5 Fr diagnostic catheters, 6 Fr guiding catheter. Of the 120 patients evaluated in the study, 52.5% underwent a 6 Fr workflow and 47.5% underwent a modified workflow. The authors found a significantly lower rate of radial artery spasm (25% vs. 43%, $p=0.03$) and need to switch to another access (2% vs. 11%, $p=0.04$), as well as lower access-related pain (3.8 ± 2.3 vs. 4.9 ± 2.2 , $p=0.04$). Although there was no significant difference in fluoroscopy time (14 ± 6 min vs. 13 ± 5 min, $p=0.36$), there was a significantly lower procedure time (17 ± 7 min vs. 22 ± 11 min, $p=0.01$) to lesion crossing with the modified workflow compared to the 6 Fr workflow. The authors concluded that a 5 Fr, as opposed to 6 Fr, diagnostic catheter strategy should be considered in women with short stature (patients with higher likelihood of TRA failure).

There are a few factors related to the present data that should be taken into consideration. First, the study was observational, and, therefore, potential confounders that may contribute to patient selection and/or operator preference of catheter selection are not readily captured. Second, details of patient peripheral anatomy, such as subclavian tortuosity, radial loops, and calcification, are not described and may further confound the results. Third, the use of a TRA-specific universal catheter has been shown to be effective when compared with a dual catheter strategy in small-randomized studies [14, 15]. However, the operators in this study were consistent in experience, anti-spasm strategy, and catheter curves used in both arms, which elevates the rigor and methodology of this non-randomized study. Furthermore, examining technique-based data is crucial to the progress of TRA practice, with the hopes of increasing TRA adoption to maximize the outcomes benefits associated with TRA versus TFA while lowering radiation exposure and/or procedure time.

A few downsides of a smaller inner diameter for diagnostic catheters include potentially less coronary artery opacification and lower threshold for catheter kinking during manipulation [16–18]. Disadvantages of smaller inner diameter for guiding catheters include the inability to perform kissing balloon inflations or bifurcation stenting, manual thrombectomy, and use of distal protection with currently available equipment in the United States. There is also the potential issue of less backup support. These disadvantages, however, can be overcome with

the use of extra-stiff wires for cannulation of the coronary arteries, guidewires with extra support during PCI, and technique modification.

Sgueglia et al. show us that downsizing catheters is associated with a higher rate of procedural success via TRA in short-stature female patients, reducing the need to switch to alternative access in this otherwise high-risk population. This is likely due to easier cross-ability through smaller, calcified, or tortuous vessels and lower propensity for arterial spasm. In the setting of severe calcification or tortuosity of coronary arteries that may resist the advancement of a stent, switching from a 6 Fr to 5 Fr guiding catheter has been also reported to allow for a safe and deep engagement [19, 20]. The use of smaller catheters or sheathless techniques—ideally the combination of both [21, 22]—further reduces the risk and/or extent of trauma to the radial artery, particularly in patients with a smaller radial artery. This not only reduces patient discomfort [23] but also leads to fewer bleeding complications and radial artery occlusions, and potentially improves preservation of long-term radial artery function [24]. Other equipment under investigation include 0.010-inch guidewires and compatible balloon catheters that may allow for more complex PCIs to be performed via smaller-diameter guiding catheters [25, 26].

While “minimalist” TRA is not a new concept in itself, barriers to the adoption of TRA include data on how to successfully and efficiently complete coronary angiography and PCI via TRA in patients with predictors of TRA failure. The additional benefits that downsized catheters can provide, such as patient safety and comfort, should encourage the interventional community to develop new coronary devices to help overcome the present limitations of downsized catheters and at the same time perform more complex TRA PCIs. Future iterations in catheters and devices, such as improved hydrophilic coatings for catheters and extremely slender 3 and 4 Fr systems, may permit the application of the radial approach to more women and reduce access site crossover rates. Downsizing should be seen as an opportunity, rather than a limitation, to set new and higher standards in patient care.

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References

- [1]. Kolkailah AA, Alreshq RS, Muhammed AM, Zahran ME, Anas El-Wegoud M, Nabhan AF. Transradial versus transfemoral approach for diagnostic coronary angiography and percutaneous coronary intervention in people with coronary artery disease. *Cochrane Database Syst Rev*2018;4:CD012318. [PubMed: 29665617]
- [2]. Ferrante G, Rao SV, Juni 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. *JACC Cardiovasc Interv*2016;9(14):1419–34. [PubMed: 27372195]
- [3]. Ibanez B, James S, Agewall S, et al. 2017 ESC Guidelines for the management of acute myocardial infarction in patients presenting with ST-segment elevation: The Task Force for the management of acute myocardial infarction in patients presenting with ST-segment elevation of the European Society of Cardiology (ESC). *Eur Heart J*2018;39(2):119–77. [PubMed: 28886621]
- [4]. Rao SV, Tremmel JA, Gilchrist IC, et al. Best practices for transradial angiography and intervention: a consensus statement from the society for cardiovascular angiography

and intervention's transradial working group. *Catheter Cardiovasc Interv* 2014;83(2):228–36. [PubMed: 24123781]

- [5]. Mamas M, D'Souza S, Hendry C, et al. Use of the sheathless guide catheter during routine transradial percutaneous coronary intervention: a feasibility study. *Catheter Cardiovasc Interv* 2010;75(4):596–602. [PubMed: 20049959]
- [6]. Saito S, Ikei H, Hosokawa G, Tanaka S. Influence of the ratio between radial artery inner diameter and sheath outer diameter on radial artery flow after transradial coronary intervention. *Catheter Cardiovasc Interv* 1999;46(2):173–8. [PubMed: 10348538]
- [7]. Dehghani P, Mohammad A, Bajaj R, et al. Mechanism and predictors of failed transradial approach for percutaneous coronary interventions. *JACC Cardiovasc Interv* 2009;2(11):1057–64. [PubMed: 19926044]
- [8]. Carvalho MS, Cale R, Goncalves Pde A, et al. Predictors of Conversion from Radial Into Femoral Access in Cardiac Catheterization. *Arq Bras Cardiol* 2015;104(5):401–8. [PubMed: 25789883]
- [9]. Abdelaal E, Brousseau-Provencher C, Montminy S, et al. Risk score, causes, and clinical impact of failure of transradial approach for percutaneous coronary interventions. *JACC Cardiovasc Interv* 2013;6(11):1129–37. [PubMed: 24139933]
- [10]. Bertrand OF, Rao SV, Pancholy S, et al. Transradial approach for coronary angiography and interventions: results of the first international transradial practice survey. *JACC Cardiovasc Interv* 2010;3(10):1022–31. [PubMed: 20965460]
- [11]. 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. *JACC Cardiovasc Interv* 2014;7(8):857–67. [PubMed: 25147030]
- [12]. Shah B, Burdowski J, Guo Y, et al. Effect of Left Versus Right Radial Artery Approach for Coronary Angiography on Radiation Parameters in Patients With Predictors of Transradial Access Failure. *Am J Cardiol* 2016;118(4):477–81. [PubMed: 27328954]
- [13]. Sgueglia GA, Todaro D, De Santis A, Conte M, Gioffrè G, Di Giorgio A, et al. Identifying strategy for ad hoc percutaneous coronary intervention in patients with anticipated unfavorable radial access: the Little Women study. *Cardiovasc Revasc Med* 2018; 19(4):411–5.
- [14]. Erden I, Golcuk E, Bozyel S, et al. Effectiveness of Handmade “Jacky-Like Catheter” As a Single Multipurpose Catheter in Transradial Coronary Angiography: A Randomized Comparison With Conventional Two-Catheter Strategy. *J Interv Cardiol* 2017;30(1): 24–32. [PubMed: 27910134]
- [15]. Chen O, Goel S, Acholonu M, et al. Comparison of Standard Catheters Versus Radial Artery-Specific Catheter in Patients Who Underwent Coronary Angiography Through Transradial Access. *Am J Cardiol* 2016;118(3):357–61. [PubMed: 27269989]
- [16]. Mehta H, Chatterjee T, Windecker S, et al. Four French catheters for diagnostic coronary angiography. *Catheter Cardiovasc Interv* 2003;58(3):275–80. [PubMed: 12594686]
- [17]. Stefanini GG, Serruys PW, Silber S, et al. The impact of patient and lesion complexity on clinical and angiographic outcomes after revascularization with zotarolimus- and everolimus-eluting stents: a substudy of the RESOLUTE All Comers Trial (a randomized comparison of a zotarolimus-eluting stent with an everolimus-eluting stent for percutaneous coronary intervention). *J Am Coll Cardiol* 2011;57(22):2221–32. [PubMed: 21616282]
- [18]. Metz D, Chapoutot L, Brasselet C, Jolly D. Randomized evaluation of four versus five French catheters for transfemoral coronary angiography. *Clin Cardiol* 1999;22(1): 29–32. [PubMed: 9929752]
- [19]. Matsukage T, Masuda N, Ikari Y. Successful transradial intervention by switching from 6 French to 5 French guiding catheter. *J Invasive Cardiol* 2011;23(6):E153–5. [PubMed: 21646664]
- [20]. Takeshita S, Tanaka S, Saito S. Coronary intervention with 4-French catheters. *Catheter Cardiovasc Interv* 2010;75(5):735–9. [PubMed: 20049960]
- [21]. From AM, Bell MR, Rihal CS, Gulati R. Minimally invasive transradial intervention using sheathless standard guiding catheters. *Catheter Cardiovasc Interv* 2011; 78(6):866–71. [PubMed: 21563290]

- [22]. Sciahbasi A, Mancone M, Cortese B, et al. Transradial percutaneous coronary interventions using sheathless guiding catheters: a multicenter registry. *J Interv Cardiol* 2011;24(5):407–12. [PubMed: 21895772]
- [23]. Gwon HC, Doh JH, Choi JH, et al. A 5Fr catheter approach reduces patient discomfort during transradial coronary intervention compared with a 6Fr approach: a prospective randomized study. *J Interv Cardiol* 2006;19(2):141–7. [PubMed: 16650242]
- [24]. Mizuno S, Takeshita S, Taketani Y, Saito S. Percutaneous coronary intervention using a virtual 3-Fr guiding catheter. *Catheter Cardiovasc Interv* 2010;75(7):983–8. [PubMed: 20146327]
- [25]. Matsukage T, Yoshimachi F, Masutani M, et al. A new 0.010-inch guidewire and compatible balloon catheter system: the IKATEN registry. *Catheter Cardiovasc Interv* 2009;73(5):605–10. [PubMed: 19309699]
- [26]. Matsukage T, Masutani M, Yoshimachi F, et al. A prospective multicenter registry of 0.010-inch guidewire and compatible system for chronic total occlusion: the PIKACHU registry. *Catheter Cardiovasc Interv* 2010;75(7):1006–12. [PubMed: 20517961]