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Pumping up best practices in radial artery access: prolonged occlusion flow-mediated dilation improves radial artery access success

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Randomised controlled trials have demonstrated the superiority of transradial access (TRA) for coronary angiography and intervention. Data show decreased rates of vascular complications, fewer bleeding events, and a mortality benefit associated with TRA in high-risk patients, such as those presenting with acute coronary syndrome. This has led to European Society of Cardiology (ESC) guideline recommendations[1] for a radial first strategy and an American Heart Association (AHA) Scientific Statement[2] in favour of radial access. Despite this evidence, adoption of TRA still lags, with some citing concerns over access failure and the resultant increase in procedure time as reasons for not transitioning to a radial first strategy. In this edition of EuroIntervention, Doubell and colleagues[3] show the effectiveness of yet another strategy to improve TRA success - prolonged occlusion flow-mediated dilation (PO-FMD).

Article, see page 1349

TRA failure rates remain low across multiple studies, occurring in approximately 5% of cases[3,4]. In cases where TRA failure occurs, 15% of cases are due to inability to access the radial artery, 50% due to inability to navigate catheters to the ascending aorta, and the remaining 35% due to inadequate catheter support[4]. Practices that increase the success rates of arterial access and navigating challenging anatomy within the arm are critical to improving TRA success. Multiple tools exist, including pre-procedure ultrasound examination of the arterial anatomy of the arm, ultrasound-guided radial artery access, and balloon-assisted tracking of diagnostic and guiding catheters. However, use of adjuncts to dilate the radial artery hold the promise of improving both radial artery access and equipment navigation through the smaller distal arterial bed.

Flow-mediated dilation (FMD) had previously been used to treat radial artery spasm[5] and resultant catheter entrapment. However, its use as an adjunctive technique to improve TRA success rates has not been tested until now. In a robustly conducted sham-controlled randomised trial, Doubell and colleagues[3] demonstrate the effectiveness of PO-FMD in improving TRA success via multiple procedural endpoints. First, it significantly reduced the number of puncture attempts compared with the sham arm (PO-FMD 1 attempt vs 2 attempts sham, $p<0.001$). This is consistent with improvements seen with ultrasound-guided access in the RAUST trial[6] (median 1 vs 2 without ultrasound, $p<0.0001$). While time to radial artery access was significantly reduced in the PO-FMD group compared with sham, the five-second reduction between the two groups is unlikely to be clinically meaningful. Greater reductions in procedure time have been noted with other interventions such as ultrasound-guided radial artery access[6]. Radial artery cannulation failure rates were also significantly reduced in the PO-FMD group (2.7%) compared with the sham FMD group (5.8%, $p=0.01$), leading to a number needed to treat of 32.3 patients to prevent one TRA cannulation failure.

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Although obtaining access is part of the battle, it is not the only challenge in reducing TRA procedural failure. The current trial did not assess whether PO-FMD reduced overall TRA procedural failure, although it is plausible the PO-FMD may have some benefit in dilating the arterial anatomy distal to the brachial artery, thereby improving catheter navigation through the distal arm to the ascending aorta. Further studies are needed to evaluate whether PO-FMD indeed reduces TRA procedural failure due to an inability to navigate catheters to the ascending aorta. Pre-procedure ultrasound of the arterial anatomy of the arm (PPUAA), used as standard of care within the study by Doubell and colleagues, is known to improve procedural success rates. The PRIMAFACIE-TRI trial[7] demonstrated that PPUAA is a simple and fast (6.4±1.8 minutes) mechanism for detecting anatomical variants (9.8% of cases) and may improve arterial access success rates (98.7% for coronary angiography, 97.5% for PCI) and decrease fluoroscopy times. Despite these techniques, there is still a small percentage of cases that remain unsuccessful, and adjunctive pre-treatment with PO-FMD may be of benefit.

While PO-FMD improved access success rates, it showed mixed results in reducing complications. No difference was noted in rates of radial artery spasm (4.6% PO-FMD vs 4.3% sham, p=0.0546) or radial artery occlusion (RAO; 3.9% PO-FMD vs 5.7% sham, p=0.2). Radial artery pulse loss was noted in fewer cases within the PO-FMD group (1.4% PO-FMD vs 3.8% sham, p=0.02). However, the study was not powered to detect differences in complication rates and was instead focused on cannulation failure. Studies have evaluated the use of FMD for prevention of radial artery spasm[8], but not other complications. Additional studies are needed to determine if PO-FMD is associated with reduced complications, including hard clinical endpoints.

Implementation of a PO-FMD strategy to improve TRA success is simple, low cost, and low risk. After appropriate pre-procedure examinations are complete, before the procedure the staff can initiate the PO-FMD protocol. Not only will this have the benefits as defined within the RADIAL trial, but it may also improve engagement of the pre-procedure/recovery room staff, making them more invested in each procedure. Furthermore, this fits seamlessly with other pre-procedure interventions, such as use of topical anaesthetics at the arterial access site. PO-FMD protocols only require a simple sphygmomanometer to implement, making them one of the lowest cost interventions to improve TRA success. There are very few risks associated with a PO-FMD intervention; however, more robust data are needed to evaluate potential risks better. RAO is unlikely to occur as vascular injury has not occurred at the time of the prolonged occlusion, an essential component to precipitating RAO[9].

Doubell and colleagues are to be congratulated for conducting the RADIAL trial. PO-FMD presents a low-cost intervention with similar results to ultrasound-guided access and PPUAA in terms of improving TRA success rates. The data presented in the RADIAL trial suggest that PO-FMD deserves to be included in the armamentarium of tools to improve TRA success. However, further data are needed to understand better the safety profile of PO-FMD, its impact on overall procedural success, and effects on other procedural clinical outcomes.

Conflict of interest statement

The authors have no conflicts of interest to declare.

References

1. Roffi M, Patrono C, Collet JP, Mueller C, Valgimigli M, Andreotti F, Bax JJ, Borger MA, Brotons C, Chew DP, Gencer B, Hasenfuss G, Kjeldsen K, Lancellotti P, Landmesser U, Mehilli J, Mukherjee D, Storey RF, Windecker S; ESC Scientific Document Group. 2015 ESC Guidelines for the management of acute coronary syndromes in patients presenting without persistent ST-segment elevation: Task Force for the Management of Acute Coronary Syndromes in Patients Presenting without Persistent ST-Segment Elevation of the European Society of Cardiology (ESC). *Eur Heart J.* 2016;37:267-315.

2. Mason PJ, Shah B, Tamis-Holland JE, Bittl JA, Cohen MG, Safirstein J, Drachman DE, Valle JA, Rhodes D, Gilchrist IC; American Heart Association Interventional Cardiovascular Care Committee of the Council on Clinical Cardiology; Council on Cardiovascular and Stroke Nursing; Council on Peripheral Vascular Disease; and Council on Genomic and Precision Medicine. An Update on Radial Artery Access and Best Practices for Transradial Coronary Angiography and Intervention in Acute Coronary Syndrome: A Scientific Statement From the American Heart Association. *Circ Cardiovasc Interv.* 2018;11:e000035.

3. Doubell J, Kyriakakis C, Weich H, Herbst P, Pecoraro A, Moses J, Griffiths B, Snyman HW, Kabwe L, Du Toit R, Joubert L, Hassan K, Doubell A. Radial artery dilatation to improve access and lower complications during coronary angiography: the RADIAL trial. *EuroIntervention.* 2021;16:1349-55.

4. Dehghani P, Mohammad A, Bajaj R, Hong T, Suen CM, Sharieff W, Chisholm RJ, Kutryk MJ, Fam NP, Cheema AN. Mechanism and predictors of failed transradial approach for percutaneous coronary interventions. *JACC Cardiovasc Interv.* 2009;2:1057-64.

5. Ying L, Xu K, Gong X, Liu X, Fan Y, Zhao H, Wang F, Khurwolah MR, Li C. Flow-mediated dilatation to relieve puncture-induced radial artery spasm: A pilot study. *Cardiol J.* 2018;25:1-6.

6. Seto AH, Roberts JS, Abu-Fadel MS, Czak SJ, Latif F, Jain SP, Raza JA, Mangla A, Panagopoulos G, Patel PM, Kern MJ, Lasic Z. Real-time ultrasound guidance facilitates transradial access: RAUST (Radial Artery access with Ultrasound Trial). *JACC Cardiovasc Interv.* 2015;8:283-91.

7. Chugh SK, Chugh S, Chugh Y, Rao SV. Feasibility and utility of pre-procedure ultrasound imaging of the arm to facilitate transradial coronary diagnostic and interventional procedures (PRIMAFACIE-TRI). *Catheter Cardiovasc Interv.* 2013;82:64-73.

8. Zencirci E, Esen Zencirci A, Degirmencioglu A. A randomized trial of flow-mediated dilation to prevent radial artery spasm during transradial approach. *Minerva Cardioangiol.* 2021 Jan 11. [Epub ahead of print].

9. Bernat I, Aminian A, Pancholy S, Mamas M, Gaudino M, Nolan J, Gilchrist IC, Saito S, Hahalis GN, Ziakas A, Louvard Y, Montalescot G, Sgueglia GA, van Leeuwen MAH, Babunashvili AM, Valgimigli M, Rao SV, Bertrand OF; RAO International Group. Best Practices for the Prevention of Radial Artery Occlusion After Transradial Diagnostic Angiography and Intervention: An International Consensus Paper. *JACC Cardiovasc Interv.* 2019;12:2235-46.