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NEW RESEARCH PAPERS

CORONARY

Distal Versus Conventional Radial Access for Coronary Angiography and Intervention

The DISCO RADIAL Trial

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ABSTRACT

BACKGROUND Currently, transradial access (TRA) is the recommended access for coronary procedures because of increased safety, with radial artery occlusion (RAO) being its most frequent complication, which will increasingly affect patients undergoing multiple procedures during their lifetimes. Recently, distal radial access (DRA) has emerged as a promising alternative access to minimize RAO risk. A large-scale, international, randomized trial comparing RAO with TRA and DRA is lacking.

OBJECTIVES The aim of this study was to assess the superiority of DRA compared with conventional TRA with respect to forearm RAO.

METHODS DISCO RADIAL (Distal vs Conventional Radial Access) was an international, multicenter, randomized controlled trial in which patients with indications for percutaneous coronary procedure using a 6-F Slender sheath were randomized to DRA or TRA with systematic implementation of best practices to reduce RAO. The primary endpoint was the incidence of forearm RAO assessed by vascular ultrasound at discharge. Secondary endpoints include crossover, hemostasis time, and access site-related complications.

RESULTS Overall, 657 patients underwent TRA, and 650 patients underwent DRA. Forearm RAO did not differ between groups (0.91% vs 0.31%; $P = 0.29$). Patent hemostasis was achieved in 94.4% of TRA patients. Crossover rates were higher with DRA (3.5% vs 7.4%; $P = 0.002$), and median hemostasis time was shorter (180 vs 153 minutes; $P < 0.001$). Radial artery spasm occurred more with DRA (2.7% vs 5.4%; $P = 0.015$). Overall bleeding events and vascular complications did not differ between groups.

CONCLUSIONS With the implementation of a rigorous hemostasis protocol, DRA and TRA have equally low RAO rates. DRA is associated with a higher crossover rate but a shorter hemostasis time. (J Am Coll Cardiol Intv 2022;15:1191-1201)

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ABBREVIATIONS AND ACRONYMS

DRA = distal radial access

ITT = intention-to-treat

PCI = percutaneous coronary intervention

PP = per protocol

RAO = radial artery occlusion

RCT = randomized controlled trial

TRA = transradial access

Over the past 3 decades, transradial access (TRA) has become the standard vascular access site for percutaneous coronary procedures, and a radial-first strategy is now advocated as the default approach in both the European Society of Cardiology/European Association for Cardio-Thoracic Surgery guidelines on myocardial revascularization and the American College of Cardiology/American Heart Association/Society for Cardiovascular Angiography and Interventions guideline for coronary artery revascularization, regardless of clinical presentation.[1,2] Such an endorsement is founded on compelling evidence from large randomized controlled trials (RCTs) and meta-analyses showing many advantages over transfemoral access.[1-4] These benefits comprise reduction of access-site bleeding and vascular complications, even in complex percutaneous coronary intervention (PCI), and reduction of mortality, especially in higher risk patients.[1-5] Moreover, TRA is associated with improved quality of life and allows safe performance of same-day discharge diagnostic and interventional procedures in patients in stable condition, contributing to the cost-effectiveness of the procedure.[3]

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Because of such relevant advantages, TRA is also gaining popularity for an expanding range of noncoronary diagnostic and interventional procedures. Indeed, other specialties, such as interventional radiology and interventional neurology, are increasingly incorporating this approach into their procedures.[6] Yet the adoption rate of TRA varies across countries, with some significant room for growth.[7]

Anatomical constraints may limit the clinical benefits of TRA, yielding a few complications, including radial artery occlusion (RAO), a complex process involving several interplaying factors ultimately leading to thrombosis. RAO is by far the most frequent complication of TRA, with highest incidence in the first 24 hours and spontaneous recanalization at 30 days in about one-half of the patients.

If adverse ischemic effects of RAO are thwarted by the extensive network of wrist and hand anastomoses, an occluded radial artery is unsuitable for a future surgical use or a further percutaneous coronary or noncoronary procedure.[8,9]

Several patient- and procedure-related characteristics have been linked to the development of RAO, and best-practice recommendations include multiple approaches to favor blood flow persistence during and after the transradial procedure.[8] In light of the increasing use of TRA in numerous interventional procedures, prevention of RAO is becoming a central consideration for achieving a successful radial program. However, the real-world incidence of RAO reported from experienced radial centers remains high, with wide variability in the uptake of RAO prevention strategies.[8]

Distal radial access (DRA) in the anatomical snuff box or the dorsum of the hand has emerged in the past few years as a promising alternative access to further reduce the risk for RAO because of the puncture site within the hand anastomotic network, which most likely ensures persistent blood flow in the radial artery.[9-11] Two recent RCTs have shown striking reductions of forearm RAO after DRA compared with conventional TRA.[12,13] The level of evidence provided by these studies is limited by their single-center design and by a high rate of forearm RAO in the conventional TRA group, which is in contrast to lower reported rates from contemporary trials using best prevention methods.[14-16] To unravel the role of DRA in current interventional practice, we performed a large, multicenter RCT to assess the efficacy and safety of DRA compared with conventional TRA with systematic implementation of best prevention methods for the reduction of RAO.

METHODS

STUDY DESIGN AND OVERSIGHT. The DISCO RADIAL (Distal vs Conventional Radial Access) trial

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(NCT04171570) was a prospective, multicenter, international, open-label RCT designed to assess the superiority of DRA compared with conventional TRA with respect to the incidence of forearm RAO at discharge. The methodology of the trial has been published previously.[17]

As conventional TRA and DRA require both specific skills and dedicated training, single operators qualified for the study providing: 1) they were experienced operators regularly performing transradial PCI in the whole spectrum of coronary artery disease, including acute coronary syndrome; 2) they were fully independent with DRA; and 3) they had performed a minimum of 100 procedures by DRA.

The DISCO RADIAL trial was sponsored by Terumo Europe, which had responsibility for study management, data collection and monitoring for high-quality data acquisition, and statistical analysis. The co-primary investigators conceived the study and developed the protocol in collaboration with the sponsor and oversaw data analysis. The first draft of the manuscript was prepared by the co-first authors. The sponsor could not require changes to the manuscript. The authors made the decision to submit the manuscript for publication and vouch for the accuracy and completeness of the data and for the fidelity of the trial to the protocol and statistical analysis plan.

TRIAL POPULATION AND RANDOMIZATION. The study enrolled patients who underwent diagnostic coronary angiography or PCI, using a 6-F Glidesheath Slender (Terumo) as the standard access sheath.[15] Patients were enrolled at centers in Europe and Japan providing operators fully proficient with both conventional TRA and DRA.

Inclusion criteria were broad in order to enroll a patient population representative of routine clinical practice. Adult patients 18 years of age or older were eligible if they provided written informed consent and were suitable for both DRA and TRA with the 6-F Glidesheath Slender. Exclusion criteria were medical conditions that may cause noncompliance with the study protocol and/or may confound the data interpretation, long-term hemodialysis, ST-segment elevation myocardial infarction, and PCI for chronic total occlusion. Patients were followed until hospital discharge.

The protocol was approved by the ethics committee at each trial center, and the study was conducted according to the Declaration of Helsinki. All patients provided written informed consent.

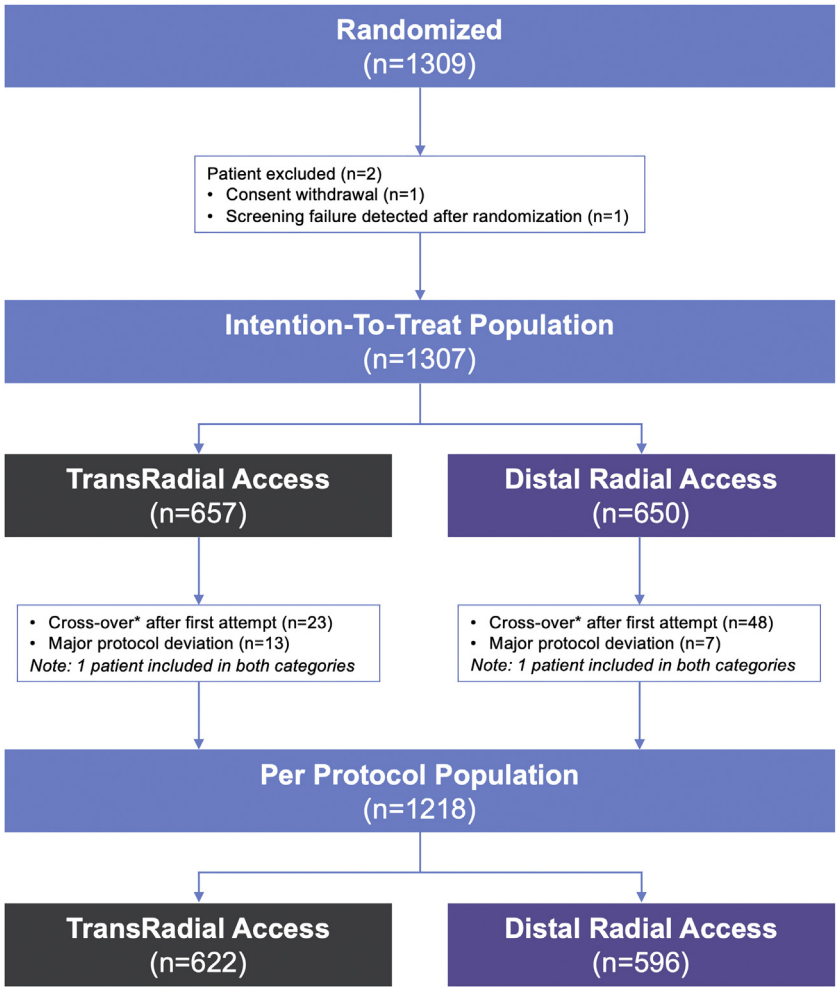
Eligible patients were randomly assigned in a 1:1 ratio to DRA vs TRA. Concealed allocation of study treatment was performed using a web-based interactive randomization system. Randomization was achieved with a computer-generated random sequence with a random block size stratified at site level.

TRIAL PROCEDURES. For patients randomized to both DRA and TRA, intravenous access for the administration of medications was recommended in the contralateral arm. The choice of right or left radial artery was left to the discretion of the operator, as was the use of ultrasound to guide arterial puncture. After local anesthesia, either the Seldinger or the modified Seldinger technique was used to obtain arterial access. After placement of the 6-F Glidesheath Slender, it was highly recommended to administer 5 mg verapamil and/or 100 to 200 mg nitroglycerin to prevent arterial spasm. Also, all patients received an initial bolus of 5,000 IU unfractionated heparin, with adjunctive bolus if needed to achieve an activated clotting time of 250 to 300 seconds according to current best practice.[1,2,8] If the initial attempt to obtain vascular access at the randomized access site (DRA or conventional TRA) failed because of refractory spasm, disproportionate pain, vessel damage, or excessive vessel tortuosity, all further attempts to obtain vascular access at another site in the same limb or in another limb were considered as crossover. This included the use of the contralateral arm, other arteries, or crossover to the other group.

For conventional TRA, the patient's hand was placed in an extended position with the palm supinated. It was advised to puncture the radial artery 2 cm proximal to the styloid process of the radial bone with a 30° to 45° entry angle to the skin. For DRA, the patient's hand was positioned with the anatomical snuff box upward. After confirming by manual palpation the presence of a well-developed distal radial artery in the anatomical snuff box or the dorsum of the hand, the artery was punctured with a 30° to 45° entry angle to the skin in the direction of the strongest pulse.[10] The anterior wall puncture technique was preferred, but the through-and-through puncture could also be used. In both cases, careful manipulation of the needle was advised to avoid touching the periosteum of the scaphoid or trapezium bones, which can be painful and in turn provoke spasm. After successful arterial puncture, the rest of the access procedure was similar as for conventional TRA.

For patients in whom arterial access was obtained through the conventional TRA, hemostasis with an air-filled closure device was recommended with

FIGURE 1 Study Flowchart



*Crossover was defined as initial failure to obtain vascular access, after which access was obtained from the contralateral arm or from another artery, or crossover to the other group.

patent hemostasis implemented according to the PROPHET (Prevention of Radial Artery Occlusion—Patent Hemostasis Evaluation Trial) protocol.[18] Briefly, after placement of the hemostatic compression device and removal of the sheath, hemostatic pressure was set to a level just enough to maintain hemostasis without compromising radial artery patency as assessed by the reverse Barbeau test. This was performed by observation of the pulsatile waveforms from a plethysmographic sensor placed on the index finger after compression of the ulnar artery. Absence of a plethysmographic waveform indicates occlusive compression of the radial artery and the pressure in the hemostatic device should gradually be reduced until return of the waveform. For patients who underwent DRA, hemostasis was per hospital practice.[10]

TRIAL ENDPOINTS AND DEFINITIONS. The primary endpoint was the incidence of forearm RAO at hospitalization discharge, assessed by an independent clinical investigator not involved in the procedure and unconcerned by the results of the trial. The presence or absence of a duplex ultrasound anterograde flow signal distal to the radial artery access site was checked according to hospital routine, ideally between 8 and 48 hours postprocedurally. The artery was considered occluded if no flow signal could be detected. For patients assigned to DRA, both the forearm and the distal arteries were assessed. The secondary endpoints included successful sheath

insertion, access-site crossover, sheath insertion time, procedure time, overall bleedings defined according to the Bleeding Academic Research Consortium criteria,[19] puncture site bleeding defined according to the EASY (Early Discharge After Transradial Stenting of Coronary Arteries Study) criteria,[20] vascular access-site complications, radial artery spasm, access-related pain rated according to self-reported visual analog scale, time to hemostasis, patent hemostasis (in the TRA group), and distal artery occlusion (in DRA group). Endpoint definitions are fully detailed in Supplemental Table 1.

STATISTICAL ANALYSIS. The primary hypothesis of the study was that DRA is superior to conventional TRA with respect to the incidence of forearm RAO at discharge. For the TRA group, the assumption was that 3.5% of patients would experience RAO on the basis of data from the 6-F Glidesheath Slender subgroup from the RAP and BEAT (Radial Artery Patency and Bleeding, Efficacy, Adverse Event) study.[15] For the DRA group, an incidence of forearm RAO of 1.0% was assumed, on the basis of numerous previous studies. For statistical power of 80% and a 2-sided alpha error of 0.05, assuming a crossover rate of 10% and a drop-out rate of 5%, 648 patients per group were needed. The total sample size was therefore set to 1,300 patients.

The primary endpoint analysis was performed on the intention-to-treat (ITT) population (ie, on the basis of randomization assignment to either the TRA or the DRA group). For the secondary endpoint analyses, the analyses were performed on the ITT and the per protocol (PP) population. The PP population excludes patients who crossed over or had major violations to the study protocol. Normality of data was assessed using the Shapiro-Wilk test, and continuous variables are reported as mean ± SD or as median (IQR) if skewed. Comparison of continuous variables was performed using Student's *t*-test or the Mann-Whitney *U* test, as appropriate. Categorial variables are reported as count (percentage), and comparative testing was performed using the chi-square or Fisher exact test, as appropriate.

A *P* value <0.05 was considered to indicate statistical significance. Statistical tests were performed using SAS version 9.4 (SAS Institute).

RESULTS

From December 2019 to October 2021, a total of 1,309 patients at 15 sites in Europe and 1 site in Japan (Supplemental Table 2) were randomized. Two patients were excluded from the primary endpoint analysis because of either screening failure detected after randomization or withdrawal of consent. The ITT population consisted of 1,307 patients, randomized to conventional TRA (n = 657) or DRA (n = 650). The PP population excluded patients who crossed over (n = 71) or those with major protocol deviations (n = 20) (Supplemental Table 3) and consisted of 1,218 patients (**Figure 1**).

Baseline patient characteristics according to randomization arm are shown in **Table 1** and were well balanced between the treatment groups. Overall mean age of the patients was 68.1 years, with 72.5% men, 29.5% with diabetes mellitus, and 78.2% with arterial hypertension. Histories of myocardial infarction were present in 23.0% of patients, 38.3% had

TABLE 1 Baseline Patient Characteristics

	TRA (n = 657)	DRA (n = 650)	*P* Value
Age, y	68.2 ± 11.1 (657)	68.0 ± 10.7 (650)	0.74
Male	71.2 (468/657)	73.7 (479/650)	0.32
Body mass index, kg/m^2	28.2 ± 5.1 (653)	27.7 ± 5.1 (648)	0.081
Current smoking	21.4 (121/566)	22.4 (126/563)	0.68
Diabetes	28.9 (190/657)	30.2 (196/649)	0.61
Hypertension	79.6 (520/653)	76.7 (496/647)	0.19
Hyperlipidemia	72.4 (472/652)	69.2 (442/639)	0.20
Previous MI	23.8 (155/651)	22.2 (142/641)	0.48
Previous PCI	40.6 (267/657)	35.9 (233/650)	0.075
Previous PCI with radial access	34.8 (228/656)	32.8 (213/649)	0.46
Previous CABG	5.5 (36/657)	5.5 (36/650)	0.96
Peripheral artery disease	10.4 (66/636)	10.5 (65/622)	0.97
Chronic coronary syndrome			
Silent ischemia	33.6 (221/657)	36.5 (237/650)	0.28
Stable angina	50.2 (330/657)	49.5 (322/650)	0.80
Acute coronary syndrome			
Unstable angina	8.7 (57/657)	7.2 (47/650)	0.33
NSTEMI	7.5 (49/657)	6.8 (44/650)	0.63
Hemoglobin, g/L	139.3 ± 16.9 (639)	139.7 ± 17.3 (639)	0.63
Hematocrit, %	41.2 ± 4.7 (622)	41.3 ± 4.7 (627)	0.65
White blood cell count, 10^9/L	7.5 ± 2.4 (636)	7.5 ± 2.3 (635)	0.88
Red blood cell count, 10^{12}/L	4.6 ± 0.6 (618)	4.6 ± 0.6 (623)	0.47
Blood platelet count, 10^9/L	232.8 ± 77.5 (618)	235.8 ± 73.1 (625)	0.48
Serum creatinine, μmol/L	87.8 ± 27.1 (640)	88.1 ± 27.1 (638)	0.82
Antiplatelet medication			
Aspirin	69.3 (455/657)	63.7 (414/650)	0.033
Clopidogrel	21.8 (143/657)	23.1 (150/650)	0.57
Ticagrelor	7.8 (51/657)	6.0 (39/650)	0.21
Prasugrel	5.0 (33/657)	3.7 (24/650)	0.24
Oral anticoagulants	13.7 (90/657)	15.1 (98/650)	0.48
Lipid lowering medication	73.5 (483/657)	70.3 (457/650)	0.20
Antihypertensive medication	82.7 (543/657)	77.7 (505/650)	0.025
Insulin	8.7 (57/657)	8.3 (54/650)	0.81

Values are mean ± SD (N) or % (n/N).

CABG = coronary artery bypass grafting; DRA = distal radial access, MI = myocardial infarction, NSTEMI = non-ST-segment elevation myocardial infarction, PCI = percutaneous coronary intervention, TRA = transradial access.

TABLE 2 Procedural Characteristics

	TRA (n = 657)	DRA (n = 650)	*P* Value
Right access side	80.5 (528/656)	80.8 (525/650)	0.90
Diagnostic angiography only	62.7 (412/657)	63.5 (413/650)	0.76
PCI	37.3 (245/657)	36.5 (237/650)	0.76
Elective PCI	17.5 (115/657)	17.1 (111/650)	0.84
Left main treated	8.2 (20/245)	8.9 (21/237)	0.78
Median number of stents implanted	1.0 (1-2) (244)	1.0 (1-2) (235)	0.36
Crossover rate	3.5 (23/657)	7.4 (48/650)	0.002
To the other access, same side	0.2 (1/657)	4.6 (30/650)	
To the other access, other side	0.0 (0/657)	0.3 (2/650)	
To the other side, same access	1.5 (9/657)	0.5 (3/650)	
To ulnar or brachial	0.3 (3/657)	0.2 (1/650)	
To femoral	1.5 (10/657)	1.9 (12/650)	
Sheath insertion time, min	1 (1-3) (655)	2 (1-4) (650)	<0.001
6-F Slender introducer sheath used	99.4 (653/657)	99.7 (648/650)	0.69
Procedure time, min	24 (14-42) (634)	27 (15-45) (627)	0.12
Contrast volume, mL	95.2 ± 73.1 (525)	91.8 ± 65.0 (531)	0.44
Radiation dose, mGy	1,222 ± 2,846 (474)	1,298 ± 3,143 (478)	0.70
Radiation dose, mSv	18.1 ± 51.5 (17)	17.6 ± 57.3 (25)	0.98
Activated clotting time, s	250 ± 87 (525)	247 ± 87 (518)	0.63
Closure device			<0.001
Selective compression device	99.2 (652/657)	88.0 (571/650)	
Bandage	0.8 (5/657)	12.0 (78/650)	
Same-day discharge	30.9 (203/657)	27.8 (181/650)	0.23
Median hospital duration, days	2.0 (1-2)	2.0 (1-2)	0.24

Values are % (n/N), median (IQR) (N), or mean ± SD (N).
Abbreviations as in Table 1.

undergone previous PCI, and 33.8% had undergone previous PCI with radial access. Almost all patients (99.4%) received antiplatelet medications, and 14.4% were taking oral anticoagulants. The majority of patients presented with chronic coronary syndrome (84.9%), while 7.1% had non-ST-segment elevation myocardial infarction and 8.0% presented with unstable angina.

PROCEDURAL CHARACTERISTICS. As shown in Table 2, similar proportions of patients underwent PCI in both treatment groups (37.3% vs 36.5%; $P = 0.76$), with a mean number of stents implanted of 1.5 and 1.4 ($P = 0.34$) in the TRA and DRA group, respectively. No difference was found in activated clotting time between groups (250 ± 87 s vs 247 ± 87 s; $P = 0.63$). Right-side access was chosen in 80.6% of patients, and the 6-F Glidesheath Slender was used in 99.5% of patients, without a significant difference between groups. Crossover rates were significantly higher with DRA (7.4% vs 3.5%; $P = 0.002$). The majority of crossover in the TRA group occurred to the opposite side (left or right) or to femoral access, while the majority of crossover in DRA occurred to conventional TRA (Table 2).

PRIMARY OUTCOME. Forearm RAO occurred in 6 patients in the conventional TRA group compared with 2 patients in the DRA group (0.91% vs 0.31%; $P = 0.29$) (Table 3, Central Illustration). Analysis of the primary endpoint in the PP population showed consistent results, with forearm RAO rates of 0.81% with conventional TRA vs 0.34% with DRA ($P = 0.45$).

SECONDARY OUTCOMES. In the ITT population, distal RAO in the DRA group was 0.46%. Radial artery spasm was more frequent in the DRA group (2.7% vs 5.4%; $P = 0.015$), yet self-reported access-related pain assessment according to the visual analog scale was 2 (IQR: 0-3) in the conventional TRA group and 2 (IQR: 0-4) in the DRA group ($P = 0.067$). Median time to hemostasis was 180 minutes with conventional TRA and 153 minutes with DRA ($P < 0.0001$). Patent hemostasis was achieved in 94.4% of patient in the conventional TRA arm. There were no differences in bleeding (5.5% vs 6.8%; $P = 0.33$) and vascular complications (1.2% vs 1.1%; $P = 0.81$) between conventional TRA and DRA. Of the puncture site-related bleeding events, the majority was classified as EASY type I (4.1% with conventional TRA vs 6.0% with DRA; $P = 0.12$). All analyses in the PP population yielded consistent results (Table 3).

DISCUSSION

The DISCO RADIAL trial was the first large-scale, prospective, multicenter, international, RCT comparing DRA with conventional TRA in patients undergoing percutaneous coronary procedures. It is also the first and unique multicenter clinical investigation systematically implementing best-practice recommendations for the reduction of RAO after conventional TRA. Indeed, to fully unravel the role of DRA in contemporary interventional practice, DISCO RADIAL was designed to compare this newer access not with each center's regular transradial practice but with conventional TRA, systematically implementing protocol-driven, up-to-date, optimal evidence-based care to preserve radial artery patency.[8] Specifically, the trial's main objective was to show the superiority of DRA over conventional TRA in terms of forearm RAO rigorously assessed using vascular ultrasound.[17] The results showed an exceptionally low incidence of primary endpoint in both groups, without a statistically significant difference between them, most likely because of type II error rate inflation.

Notably, the incidence of forearm RAO in the conventional TRA group was extremely low for a multicenter TRA trial. Such a finding supports

TABLE 3 Primary and Secondary Outcomes at Discharge

	Intention-to-Treat			Per Protocol		
	TRA (n = 657)	DRA (n = 650)	*P* Value	TRA (n = 622)	DRA (n = 596)	*P* Value
Forearm radial artery occlusion	0.91 (6/657)	0.31 (2/650)	0.29	0.80 (5/622)	0.34 (2/596)	0.45
Distal radial artery occlusion	NA	0.46 (3/650)	–	NA	0.50 (3/596)	–
Radial artery spams	2.7 (18/657)	5.4 (35/650)	0.015	2.1 (13/622)	4.4 (26/594)	0.024
Hemostasis time, min	180 (134-292) (593)	153 (105-242) (581)	<0.0001	180 (130-292) (559)	148 (101-240) (534)	<0.0001
Patent hemostasis achieved[a]	94.4 (620/657)	NA	–	95.3 (593/622)	NA	–
Patent hemostasis used, not achieved[a]	4.4 (29/657)	NA	–	4.2 (26/622)	NA	–
No patent hemostasis used[a]	1.2 (8/657)	NA	–	0.5 (3/622)	NA	–
Pain, visual analog scale score	2 (0-3) (651)	2 (0-4) (643)	0.067	2 (0-3) (616)	2 (0-4) (591)	0.045
Bleeding	5.5 (36/657)	6.8 (44/650)	0.33	5.5 (34/622)	5.7 (34/596)	0.86
Non-puncture site–related bleeding	0.3 (2/657)	0.0 (0/650)	0.50	0.3 (2/622)	0.0 (0/596)	0.50
Puncture site–related bleeding	5.2 (34/657)	6.8 (44/650)	0.22	5.1 (32/622)	5.7 (34/596)	0.67
EASY type I	4.1 (27/657)	6.0 (39/650)	0.12	4.3 (27/622)	5.2 (31/596)	0.48
EASY type II	0.8 (5/657)	0.3 (2/650)	0.45	0.7 (4/622)	0.2 (1/596)	0.37
EASY type III	0.2 (1/657)	0.3 (2/650)	0.62	0.0 (0/622)	0.2 (1/596)	0.49
EASY type IV or V	0.0 (0/657)	0.0 (0/650)	–	0.0 (0/622)	0.0 (0/596)	–
None	0.2 (1/657)	0.2 (1/650)	0.99	0.2 (1/622)	0.2 (1/596)	0.99
Bleeding, BARC type 1	5.2 (34/657)	6.0 (39/650)	0.52	5.1 (32/622)	4.9 (29/596)	0.82
Bleeding, BARC type 2	0.3 (2/657)	0.8 (5/650)	0.29	0.3 (2/622)	0.8 (5/596)	0.28
Bleeding, BARC types 3-5	0.0 (0/657)	0.0 (0/650)	–	0.0 (0/622)	0.0 (0/596)	–
Vascular complications	1.2 (8/657)	1.1 (7/650)	0.81	0.5 (3/622)	0.5 (3/596)	0.99

Values are % (n/N) or median (IQR) (N). [a]Only in TRA arm.

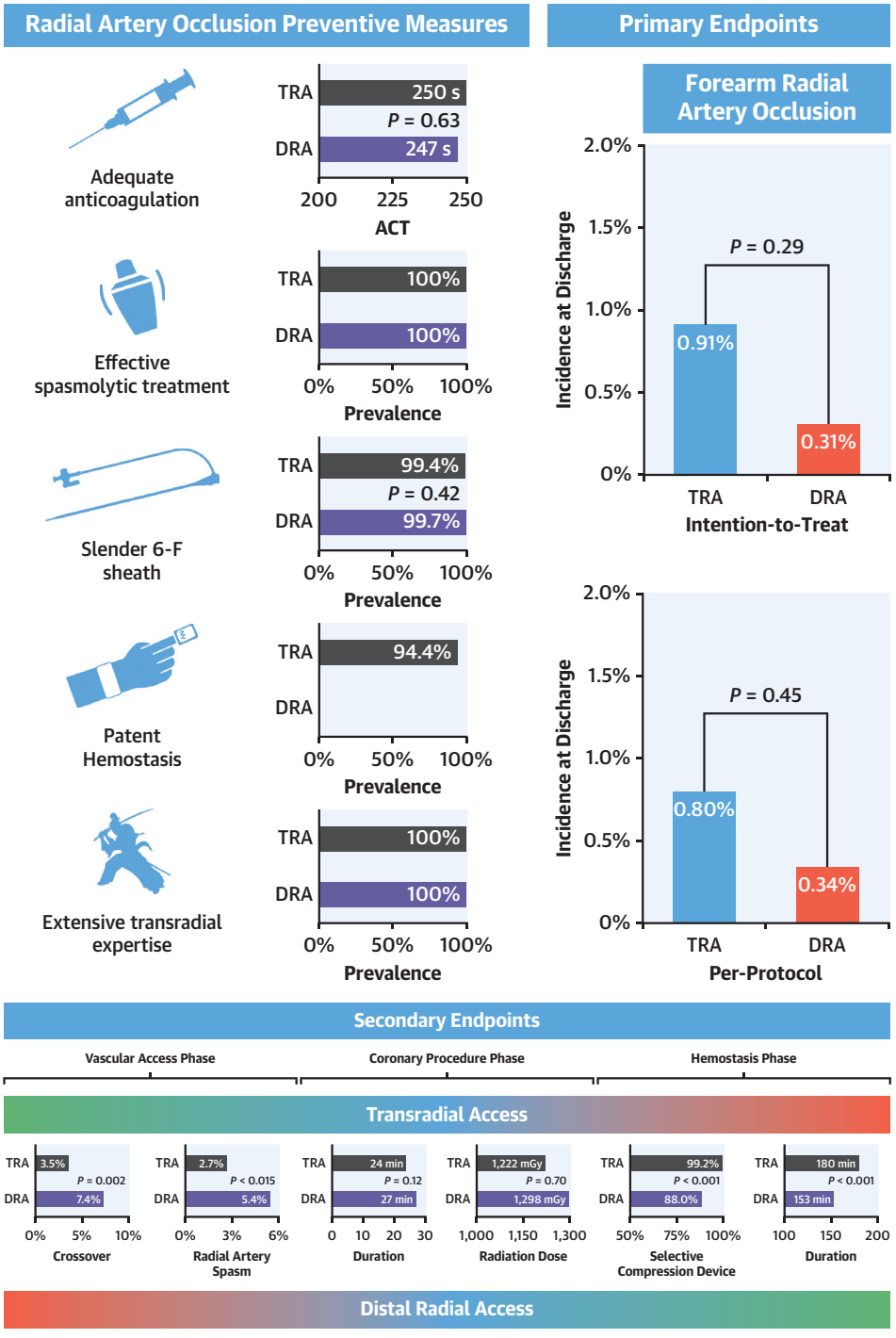
BARC = Bleeding Academic Research Consortium; EASY = Early Discharge After Transradial Stenting of Coronary Arteries Study; NA = not applicable; other abbreviations as in Table 1.

the clinical application of best-practice recommendations for the reduction of RAO and sets a new benchmark for conventional TRA. In 2 meta-analyses from 2016 and 2017, early RAO rates were 7.7% and 5.6%.[21,22] As a result of the adoption of specific preventive strategies, early RAO rates were reduced to <3% in following landmark RCTs, which were performed at highly experienced radial centers with distinct use of Slender techniques and improved hemostasis protocols.[14-16] Yearning for a synergistic benefit, the DISCO RADIAL protocol mandated the rigorous and concurrent application of the most relevant strategies shown to favorably affect RAO occurrence: reduction of the sheath's outer diameter, adequate procedural anticoagulation, nonocclusive hemostasis, and a minimal pressure strategy with short hemostasis time. Notably, the use of the thin-walled 6-F Glidesheath Slender with outer diameter reduced from 2.63 to 2.46 mm[15] is especially valued in the slightly smaller distal radial artery and has been set as the default sheath for both TRA and DRA in order to exclude variation in access devices as a confounding factor. Unique to the DISCO RADIAL trial are also strict operator criteria for eligibility, ensuring extended operating experience with both access routes.

Such an integrated approach proved highly beneficial, yielding effective patent hemostasis in 94.4% of cases and RAOs rate of 0.91% according to ITT analysis and 0.81% according to the PP analysis.

Conspicuously, the forearm RAO rate in the DRA group was even lower, about 3 times less than with conventional TRA. Following on exciting results from observational clinical registries, 7 RCTs have been performed to compare DRA with conventional TRA.[12,13,23-27] Overall results of those comparative assessments are quite conflicting, with forearm RAO rates ranging from 2.5% to 8.4% following conventional TRA and from 0% to 5% following DRA. These studies have several limitations, including a single-center design in all but one of them, heterogenous hemostasis techniques that are not oriented to RAO prevention, an essentially high rate of RAO, and its inconsistent definition across the studies. The recently published DAPRAO (Distal Radial Approach to Prevent Radial Artery Occlusion) study and ANGIE (Anatomical Snuffbox for Coronary Angiography and Interventions) study are the only 2 RCTs comparing DRA with conventional TRA including forearm RAO as the primary endpoint.[12,13] Yet they are similarly limited by their single-center designs and by high rates of forearm RAO in the conventional TRA group

CENTRAL ILLUSTRATION Key Findings of the DISCO RADIAL Trial



Aminian A, et al. J Am Coll Cardiol Intv. 2022;15(12):1191–1201.

With thorough compliance with best-practice recommendations for radial artery occlusion prevention, the DISCO RADIAL (Distal vs Conventional Radial Access) trial showed equally very low incidence of its primary endpoint following conventional transradial access and distal radial access (DRA). Secondary endpoint comparison showed that DRA had no impact on coronary procedure performance but introduces a trade-off between the simplicity of the vascular access and the safety of the hemostasis process. ACT = activated clotting time(s); DRA = distal radial access; TRA = transradial access.

(8.8% in DAPRAO and 7.9% in ANGIE, both according to ITT analysis), which is in contrast to best prevention methods to lower RAO rates. Oddly, forearm RAO rates in the DRA groups of both studies were also prominently higher than in the DISCO RADIAL trial (1.2% in DAPRAO and 3.7% in ANGIE, both according to ITT analysis).

In contrast to the extensive data supporting conventional TRA, the rates of successful cannulation, procedural complications, and overall safety of DRA are limited to relatively small single-center studies[12,13,23-27] and several meta-analysis providing inconsistent results.[28-30] Secondary endpoints and procedural characteristics are highly valuable to better put DRA into perspective. Crossover in DRA was 7.4%, twice the rate as in conventional TRA, but compares well with crossover rates in the DRA group of the DAPRAO study (13.3%) and the ANGIE study (22.3%). Yet it occurred mainly with ipsilateral conventional TRA, making it possible to continue with the initial vascular access strategy, supporting an extended access array in the upper limb, and waiving transfemoral access that would abolish the safety benefits of TRA.

Also, DRA was associated with twice the incidence of radial artery spasm but similar patient self-reported pain rating, thus reassuring against a more unpleasant experience with DRA. The rates of radial artery spasm in both groups were higher than in previous RCTs on DRA[12,13,23,24,26] and reflect the more rigorous and conservative definition provided in the DISCO RADIAL trial.[17]

Compared with conventional TRA, time to successfully achieving DRA was only slightly longer, while no differences were seen in procedural duration, use of contrast medium, and radiation dose. Although these findings were unreported in the DAPRAO study, both procedure time and radiation dose were higher in the DRA group in the ANGIE study.[13]

After the procedure, to achieve hemostasis, selective compression devices were used significantly less frequently in DRA patients. Yet as previously reported, DRA was associated with a shorter hemostasis time and a similarly low rate of vascular complications and mostly trivial puncture site-related bleeding.[31] The swiftness of the hemostasis process appears to be a major determinant of the very low rate of forearm RAO and represents one of the most appealing advantages of DRA over traditional TRA.

Overall, as the first large international trial, the results of DISCO RADIAL give a unique snapshot on the current practice of DRA in experienced radial centers around the world (**Central Illustration**). Limitations and advantages over conventional TRA appear related to the start and end of the vascular access procedure, with no impact on the coronary procedure itself. Indeed, the curvilinear anatomy and the smaller size of the distal radial artery challenge vessel puncture and guidewire advancement.[9] Yet ultrasound guidance may increase access success but requires a learning curve for untrained operators. However, the same small size of distal radial artery, coupled to its superficial course over a bony floor made of the scaphoid and trapezium bones, favors reliable, quick, and harmless hemostasis. In simple terms, the difficulty of distal radial puncture is the cost for low RAO rates with a simple hemostatic process.

STUDY LIMITATIONS. Although DISCO RADIAL was the largest multicenter randomized trial comparing conventional TRA and DRA, some limitations need to be addressed. The sample size was calculated on the basis of a conservative estimation of RAO rates to yield an adequately powered trial. However, the impact of the lower than anticipated incidence of RAO in both groups may have led to the difference between groups being nonsignificant when it actually is significant. Given the time dependency of primary PCI, patients with ST-segment elevation myocardial infarction were excluded from enrollment in the present trial. Use of the lowest diameter access sheath necessary to perform the procedure is recommended to reduce the RAO rates,[8] and using a 5-F sheath could have been a logical choice. Yet the study protocol mandated using same thin-walled 6-F sheath to avoid heterogeneity among patients and achieve the best balance between sheath thickness and convenience for everyday interventional practice. Given that no proper test has been so far developed to assess persistent flow in the distal radial artery during hemostatic compression, the study protocol did not mandate a specific hemostatic protocol in the DRA group. The consequent lack of homogeneity between conventional TRA and DRA patients, however, made it possible to assess liberal hemostasis with DRA compared with a strict hemostasis protocol after conventional TRA. The modified EASY classification could have increased the understanding of puncture site-related bleeding in the DRA group.[13]

CONCLUSIONS

In the DISCO RADIAL trial, the rate of forearm RAO was extremely low following both conventional TRA and DRA, without a statistically significant difference between them. Conventional TRA remains the gold-standard vascular access given thorough

compliance with best-practice recommendations for RAO avoidance, which establishes as a mandatory new reference in transradial practice. At the same time, DRA emerges as a valid alternative developing on a noteworthy trade-off between a more demanding and uncertain arterial puncture and safer and simpler postprocedural vascular access care.

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PERSPECTIVES

WHAT IS KNOWN? DRA has emerged as a promising alternative to conventional radial access for a further reduction of RAO rates. Large-scale, international trials investigating the benefits of distal radial with respect to conventional TRA providing systematic implementation of best practice to reduce RAO are currently lacking.

WHAT IS NEW? Results from the large, international, multicenter DISCO RADIAL RCT showed equally very low incidence of forearm RAO. These results establish compliance with best-practice recommendations for RAO avoidance as a mandatory new reference in transradial practice. At the same time, the distal radial artery arises as a valid alternative associated with higher crossover rates but with a simpler and shorter hemostasis process.

WHAT IS NEXT? Further study is required to determine whether such a strict fulfillment of conventional TRA to best practices favoring radial blood flow persistence is maintained in real-world settings. Also, predictors of DRA failure remain to be explored.

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KEY WORDS distal radial access, percutaneous coronary intervention, radial artery occlusion, randomized trial, transradial access

APPENDIX For supplemental tables, please see the online version of this paper.