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INTERVENTIONAL RADIOLOGY

ORIGINAL ARTICLE

Most common misconceptions about transradial approach in interventional radiology: results from an international survey

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PURPOSE
We aimed to assess the use of transradial approach (TRA) among interventional radiologists (IRs) and its perceived advantages and disadvantages that have driven the decision to select or refuse this endovascular approach.

METHODS
A multicountry survey of 20 multiple-choice questions was conducted among interventional radiologists in Europe and the United States. Questions assessed demographic information of the participants and whether they performed TRA routinely, pre-procedural screening modalities for TRA, TRA technique, complications, reasons for adopting TRA and reasons for not adopting TRA. A total of 187 IRs completed the survey.

RESULTS
One hundred respondents (53.5%) performed TRA routinely. TRA was chosen based on the procedure (90%, mostly embolization) and physical examination (75%). Patient preference (79%) and faster patient ambulation/discharge (73%) were the main drivers for TRA. Long learning curve (45%), lack of training (32%), prolonged procedural time (31%), potential risk for neurological complications (31%), and increase in radiation exposure (28%) were the most frequent detractors. TRA use was significantly higher in the US than in Europe ($p < 0.001$) and among male IRs than female IRs ($p < 0.01$). There was a declining trend in use of TRA with advanced age and more years of experience of IRs.

CONCLUSION
TRA usage among IRs is limited by issues that can easily be addressed. This survey could help IRs to better understand the real advantages of TRA and how it can offer higher value in patient care.

Transradial approach (TRA) for endovascular interventions was introduced by Lucian Campeau in 1989 (1). TRA gained great popularity in the hemodynamic and interventional cardiology community during the last three decades, with studies demonstrating its safety, feasibility, and superiority compared with the transfemoral approach (TFA). TRA has been proven to have less access site complications and lower mortality compared with TFA and has been adopted as the first-line approach for most coronary interventions (2–4). However, TRA remains underused by vascular interventional radiologists (IRs) regardless of its large-scale diffusion among their medical specialty "cousins". Most frequent reasons reported by IRs for not using TRA include lack of training, perceived disadvantages and fear of complications with no clear benefit. There is limited information on the overall use of TRA by IRs and reasons for not adopting it.

The goal of this multicountry survey among IRs is to assess the use of transradial approach (TRA) and its perceived advantages and disadvantages that have driven the decision to select or refuse this endovascular approach, dispelling doubts on its safety and feasibility.

Methods

The Radial Access for Visceral Interventions (RAVI) survey consisted of 20 multiple choice questions and was presented to IRs who attended the last Mediterranean In-

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terventional Oncology (MIO-Live 2019) congress in Europe or the Association of Chiefs in Interventional Radiology (ACIR, USA). The survey was also posted at the Society of Interventional Radiology online open forum named SIR connect (connect.sirweb.org). The first 6 questions were aimed to obtain demographic information on the participants as well as their field of interest. Three questions were related to the screening of patients suitable for transradial approach. Six questions assessed intraprocedural variables, choices, and preferences. Two questions addressed TRA complications. The last 3 questions were aimed at understanding the reasons for the choice or refusal of TRA. One question asked for suggestions and impressions on how to improve TRA. Three questions allowed multiple answers. The complete list of survey questions can be found in the Appendix.

Participant demographics

A total of 187 IRs (n=74, 39.6% from Europe; n=113, 60.4% from the US) completed the survey (160/187, 85.6% male; 27/187, 14.4% female, Q1). Of respondents, 65.8% (123/187) were >40 years old (Q2), with 79.1% of the total having more than 5 years of experience (Q3). The majority of respondents (54.0%, 101/187) were from public hospitals, while 35.3% (66/187) were from academic hospitals (Q4). Overall, 80.7% of the respondents indicated vascular interest, 79.7% interventional oncology interest, and 52.4% nonvascular interest (Q5). In total, 100 respondents (53.5%) performed TRA (Q6) (Table).

Statistical analysis

Frequencies and percentages were calculated and statistical significance were assessed using chi-square test or Fisher exact test, as appropriate. Univariate analysis was performed based on the demographic information and field of interest to identify predictors in the TRA uses. All tests were two sided, and *p* values <0.05 were considered to indicate statistical significance, unless otherwise specified. All analyses were conducted using SAS 9.4 (SAS Institute).

Table. Surveyed population demographics and areas of interest: univariate analysis on TRA use

		TRA use		Total	
		Yes, n (%)	No, n	n	
	Total	100 (53.5)	87	187	*p*
Country	US	87 (77.0)	26	113	<0.001
	EU	13 (17.6)	61	74	
Gender	M	92 (57.5)	68	160	0.007
	F	8 (29.6)	19	27	
Age (years)	<30	0 (0)	4	4	<0.001
	30–40	39 (65.0)	21	60	
	40–50	41 (51.9)	38	79	
	>50	20 (45.5)	24	44	
Years of expertise	<5	25 (65.8)	13	38	0.015
	5–15	44 (59.5)	30	74	
	>15	30 (40.5)	44	74	
Public hospital	Y	50 (49.5)	51	101	0.24
	N	50 (58.1)	36	86	
Academic hospital	Y	33 (50.0)	33	66	0.48
	N	67 (55.4)	54	121	
Vascular interest	Y	87 (57.8)	64	151	0.020
	N	13 (36.1)	23	36	
IO interest	Y	76 (51.0)	73	149	0.18
	N	24 (63.2)	14	38	
Non-vascular interest	Y	52 (53.1)	46	98	0.91
	N	48 (53.9)	41	89	

TRA, transradial approach; US, United States; EU, European Union; M, male; F, female; Y, yes; N, no; IO, interventional oncology.

Main points

- Limitations to transradial approach diffusion among interventional radiologists seems to be mostly based on perceived limitations and not on real literature data.
- The main reason for adopting transradial approach is patient's preference and faster patient ambulation/discharge.
- Transradial approach can represent a good alternative to transfemoral approach in the field of interventional oncology.

Results

The majority of respondents uses TRA for embolization procedures (87% for liver; 75% for pelvic embolization) (Q7), mainly selected based on procedure type (90%) and/or patient physical examination (75%) (Q8). A strong majority (98%) of operators do perform some type of screen to evaluate whether the patient is suitable for TRA (Q9). Allen and/or Barbeau tests (5, 6) is used by 78% of the surveyed IRs and an ultrasound exam of the radial artery is used to evaluate patency and antero-posterior diameter (to check compatibility with the introducer sheath) by 54% of the IRs. These exams are mostly performed outside the angio-suite just before the procedure.

In terms of TRA technique, ultrasound-guided puncture was performed by 94% of respondents (Q12), with left arm as the only or preferred arm used for TRA by 90% (Q10). The preferred room set-up in 76% of operators was placing the patient's arm on a support, in a lateral position, at about 90 degrees of abduction from the body (Q11). The vast majority of respondents (93%) deemed mandatory the intraprocedural infusion of heparin and vasodilators via the radial vascular sheath to prevent complications (Q13), and the use of dedicated devices for TRA visceral/peripheral procedures (71%) (Q14). There was no difference in terms of preferred technique used for hemostasis between manual compression and the use of dedicated compression device (63% vs. 66%), some using both of them (Q15).

Regarding complications, TRA to TFA conversion rate was lower than 5% in 83% of

respondents, and lower than 1% for 68% of respondents (Q16). Almost all respondents (96%) had a global complication rate (major and minor) for TRA of less than 5% (Q17).

When asked to choose a reason to use TRA (Q18), with more than one possible answer, the majority of respondents indicated patient preference and faster patient ambulation/discharge (79% and 73%, respectively). Reduction of bleeding complications and a less intensive postprocedure observation or care were considered less important in the approach selection.

The most common reasons for not performing TRA (Q20) were the long learning curve needed (45%), lack of training (32%), prolonged procedural times (31%), potential higher risk for neurological complications (31%), and the perceived increase in radiation exposure (28%).

Responders who used TRA also gave their opinion on how to better perform TRA (Q19), suggesting the necessity of implementation of longer (87%) and lower-profile (68%) devices.

The use of TRA was significantly more common for operators in the US than in EU (77% vs. 18%, respectively, $p < 0.001$). Statistically significant differences were noted in proportion of TRA use depending on gender (male vs. female: 58% vs. 30%, respectively, $p = 0.007$), age group (<30, 30–40, 40–50, and >50 years: 0%, 65%, 52%, 46%, respectively, $p < 0.001$), years of experience (<5, 5–15, and >15 years; 66%, 60%, and 41%, respectively, $p = 0.015$) and vascular interest (yes vs. no; 58% vs. 36%, respectively, $p = 0.020$). The differences in proportion of TRA use depending on the hospital type (public vs. private; 50% vs. 58%, respectively, $p = 0.24$ and academic vs. non-academic; 50% vs. 55%, respectively, $p = 0.48$), interventional oncology interest (yes vs. no; 51% vs. 63%, respectively, $p = 0.18$), and the nonvascular interest (53% vs. 54%, respectively, $p = 0.90$) were not statistically significant (Table).

Discussion

Our survey aimed to assess the adoption of TRA among vascular and oncologic interventional radiologists, its potential driving factor, understanding the reasons of refusal, as well as to analyze the patients' pre-, intra- and postprocedural management. Results from the RAVI survey demonstrated that the main reason for adopting TRA is patient preference and the faster patient ambulation/discharge, as greatly demonstrated by previous published papers (7–19). In detail, no need of pre-procedural groin preparation, less postprocedural discomfort at the access route, and reduced limitations for the patient in performing basic activities (i.e., without a need for procedural Foley catheter placement) have to be considered among procedural advantages for selecting TRA versus TFA.

Survey results underlined the safety of TRA, with an extremely low conversion to TFA as well as intraprocedural complication rates. These positive results were obtained performing a standardized approach, using an adequate screening process for almost all procedures, mostly performed outside the angio-suite, based on Allen and/or Barbeau tests and ultrasound assessment of radial artery diameter. Furthermore, there is a clear preference for left TRA for infra-diaphragmatic interventions both to reduce the risk of neurologic complications and due to the easier catheterization of descending aorta and shorter distance to the target vessel compared with right TRA. Adequate intraprocedural infusion of heparin and vasodilators via the radial vascular sheath to prevent complications, as spasm or radial artery occlusion, has been a widely spread practice, as well as the use of dedicated devices for visceral/peripheral procedures. Regarding postprocedure hemostasis, the lack of difference between the use of manual compression or dedicated compression devices could be justified by the cost of compression devices and the feasibility of manual compression based on fast and easy application and low risk of radial artery occlusion owing to the use of low profile dedicated introducer sheaths as demonstrated by Saito et al. (20, 21).

Nonetheless, TRA is still underused in interventional radiology, both for oncologic and vascular procedures, in particular among the European operators. TRA use was statistically significantly higher in the US than in the EU. This could be due to the higher number of outpatient intra-arterial locoregional procedures performed in the US, in which TRA, allowing faster patient ambulation and discharge, could be preferred. Furthermore, it could also be related to the increased prevalence of obesity in the US, considering that in obese patients the TFA approach could raise more procedural complications.

The survey demonstrated that the main barriers for TRA adoption by IRs are the perception that it is associated with longer learning curve, potential increased risk of stroke, longer procedural time and increase in radiation exposure. However, current literature indicates that these are only misperceptions and perceived limitations or obstacles (17, 18, 20–27).

Concerns regarding familiarity with the TFA technique represent a potential barrier for TRA wide acceptance, with a lower proportion of use of a transradial "new" approach, in particular for well-experienced operators. A higher proportion of TRA use was observed in the 30–40 years age group and in the 40–50 years age group. We could speculate that some well-experienced IRs (>50 years age group) may have the perception that there is no reason to move from femoral to radial access due to their low complication rates in TFA, associated to their great familiarity with this approach, as opposed to the need of a longer learning curve required for TRA, as also referred by many respondents. However, Iezzi et al. analyzed angiographic and patient/procedural parameters in a TRA and TFA comparative study in lobar hepatic chemoembolizations performed by a TRA-untrained interventional radiologist (22). The study suggests that once the operator has reached proficiency in TRA, both arterial accesses have similar results in quantitative and qualitative variables, with a threshold of only 20 procedures needed to overcome the learning curve. Although these results differ from other studies, it can be explained by the selection of a relatively easy procedure, as well as by the use of ultrasound-guidance during puncture and a pre-screening evaluation of patients. These two key pillars of TRA are aligned with best practices and have been adopted by the majority IRs who use TRA. Also, the use of a single-catheter technique, usually used in most embolization procedures, reducing the number of over-the-wire catheter exchanges, can greatly reduce the risk of radial artery spasm and dissection, making the procedure easy and safe.

With regards to neurologic complications, prospective randomized trial and retrospective studies that aim to analyze the risk of stroke in TRA versus TFA during percutaneous coronary interventions showed no differences in the incidence rate. It is well known that these results cannot be completely translated to non-coronary proce-

dures, as most interventional radiology treatments are performed below the origin of the epiaortic vessels as opposed to coronary interventions which always cross the aortic arch regardless of the approach (23, 24). However, similar results were confirmed in retrospective published studies on non-coronary TRA interventions (7–18, 25), confirming the safety of access, even if the theoretical risk of cerebral microemboli formation should be taken into account and would be most comprehensively addressed through a future prospective study. For reducing the potential risk, a great importance is given to the access site: the left arm allows the operator to avoid crossing epi-aortic vessels other than the left subclavian artery, minimizing the risk of dissection and/or plaque embolization to the intracranial arteries.

Another main misperception seems to be represented by the longer procedural time and increase in radiation exposure associated with TRA access. In particular, a study by Yamada et al. (18) demonstrated a reduction in radiation exposure to the operator, measured by air kerma, in TRA compared with TFA during intra-arterial therapy for liver cancer. In their study, TRA was performed from the left arm under US-guidance, with the arm abducted to 75°–90°, as also preferred by 69% of our survey respondents. The lower operator radiation exposure was made possible both by the arm positioned more distant from the radiation source and by the placement of a radiation shield interpositioning the angiography equipment and the operator. It demonstrated similar total procedure time and patient radiation exposure in TRA and TFA. Similar results were also shown by Loewenstern et al. (17) in a propensity-score retrospective study that compared patient radiation exposure in TRA versus TFA during transarterial radioembolization. Patient radiation exposure, measured by fluoroscopy time, dose-area product, and cumulative air kerma, was not significantly different between the two approaches.

Even if this is the first international survey focused on TRA among IRs, it is mainly limited by the relatively low number of respondents obtained, representing a tiny fraction in comparison to the number of active IRs in the world. It also presents a selection bias, as responders were included based on participating at a specific interventional radiology meeting or being part of a specific association of IRs. Also, countries outside Europe or the US were not included. Another bias is the fact that IRs who have adopted and understand the benefits of TRA were potentially more inclined to respond the survey. Therefore, the results may not reflect the overall opinion of the IR community for locoregional treatments (26, 27). Also, the survey done for the European community was performed during a conference primarily focused on liver-directed oncologic therapy. On the other hand, the survey in USA was performed through an online open forum (probably the best way among the 3 survey sources); however, it was also performed at a seasoned division Chiefs meeting which may represent a selection bias against TRA. Moreover, physicians are a professional group with low survey response rates in general (26, 27). Furthermore, the types of complications with TRA were not discriminated.

In conclusion, the results of this international survey provided a perspective on the attitudes of IRs towards TRA, allowing us to obtain a comprehensive view of general perceptions of IRs. Many strengths as well as several potential critical issues of TRA were analyzed. Pre-procedural screening, TRA technique, complications and most frequently provided reasons for not adopting TRA were described, discussed, and the misconceptions were explained as demonstrated by published literature. The profile of the IR most likely to adopt TRA was also characterized. TRA seems to have increased adoption among younger IRs; it is a promising, safe, and effective arterial access in comparison to TFA for intra-arterial interventions.

Conflict of interest disclosure

The authors declared no conflicts of interest.

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Appendix

1. Gender:
   a. Male 160
   b. Female 27
2. Age (years):
   a. <30 4
   b. 30–40 60
   c. 40–50 79
   d. >50 44
3. Years of experience:
   a. <5 39
   b. 5–15 74
   c. >15 74
4. Type of practice
   a. Public hospital 99
   b. Academic hospital 65
   c. Other (private) 23
5. Field of interest:
   a. Vascular 111
   b. Interventional oncology 175
   c. Nonvascular 58
6. Do you perform transradial approach (TRA)?
   a. Yes (go to question 7 100
   b. No (go to question 20) 87
7. Do you use TRA for (more than one option is allowed):
   a. Aorto-Iliac revascularization 23
   b. Hepatic procedures 87
   c. Pelvic procedures 75
   d. Infrainguinal procedures 21
8. How do you select patients for TRA? (more than one option is allowed):
   a. Based on operator preference 60
   b. Based on procedure type 90
   c. Based on physical examination 75
   d. Based on vascular status 55
9. Do you perform a screening for TRA? (more than one option is allowed):
   a. No 2
   b. Yes, only in elderly patients 2
   c. Yes, only in complex procedures 1
   d. Yes, outside the angio suite (preparation room) 44
   e. Yes, in the angio suite just before procedure 20
   f. Yes, based on Barbeau's test 78
   g. Yes, based on Allen's test 19
   h. Yes, based on ultrasound-check (radial diameter) 54
10. What is your preference for TRA?
   a. Only left arm is used 48
   b. Left arm is preferred 42
   c. Both arms are used 10
11. What about lab set-up?
   a. Dedicated set-up: Arm board with lateral arm in abduction position is used (about 60°–90°) 76
   b. Standard set-up: arm is carried along the body after radial artery access 24
12. Do you perform a US-guided puncture?
   a. No, standard palpation technique is used 1
   b. Only after failure with using standard palpation technique 1
   c. Only in selected patients 4
   d. Yes, in all patients 94

13. What about intraprocedural medications?
    a. Heparin and vasodilator are usually infused via radial sheath 93
    b. Vasodilator is only infused in case of vasospasm 1
    c. Heparin is only infused in case of radial thrombosis 0
    d. Standard systemic infusion of heparin is used 6
14. What about devices/supplies for TRA?
    a. I usually use standard devices 15
    b. I usually use dedicated cardiological devices 14
    c. I usually use dedicated devices for visceral/peripheral procedures 71
15. Patent hemostasis for TRA:
    a. Manual and mechanical compression is usually performed 63
    b. Dedicated compression devices are usually used 66
16. What is your conversion rate from radial to femoral access?
    a. <1% 48
    b. <5% 35
    c. <10% 17
    d. >10% 0
17. What is your complication rate (minor and major) in TRA?
    a. <1% 68
    b. <5% 28
    c. <15% 4
    d. More than 15% 0
18. Why do you use TRA?
    a. Patient preference 79
    b. Faster patient discharge 73
    c. Reduction of bleeding complications 59
    d. Less intensive postprocedure observation/care 58
    e. Other (please explain) 18
19. What could be improved for TRA?
    a. Longer devices 87
    b. Low-profile devices 68
    c. Guidelines for intraprocedural medications 0
    d. Radial lounges 30
    e. Hemostatic devices 24
    f. Other (please explain) 14

IF NO

20. Why do you not use TRA?
    a. Increased radiation exposure 24
    b. Prolonged procedure times 27
    c. Complex vascular anatomy 4
    d. Distance from the access site 12
    e. TRA has a long learning curve 39
    f. Potential higher risk for vascular complications 20
    g. Potential higher risk for neurological complications (stroke) 87
    h. Lack of training 28
    i. TRA offers no advantages 19
    j. Other (please explain) 1