Review Article

Transradial Catheterization, a Critical Review with Comparison Between Right and Left Access: Insight into the Clinical Applicability of Each Approach

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Transradial catheterization (TRC) for coronary angiography (CA) or coronary intervention (CI) is becoming increasingly popular and its use has been expanding worldwide. TRC has proven to be safe, efficient, and more comfortable compared to transfemoral catheterization (TFC).[1] TFC is associated with a significant risk of access site complications, which represents a special concern in patients who require full anticoagulation and/or antiplatelet therapy, especially the elderly and severely obese patients who are at higher risk.[2] In addition, hospitals expect procedures to be performed with lower cost, and with efficient patient turnover. Whether for CA or CI, TRC yields a high success rate along with early ambulation and significantly lower access site complications.[3]

Recent data[4,5] show that many countries and institutions are still reluctant to use this technique. This reluctance may be due to obstacles in the operator's mind, or to questions of skill or institutional policy, or other factors. The objective of this study is to review TRC for CA/CI from the perspective of more awareness and sensitization, since we believe that this "elegant" technique should become the preferred access route for most interventionalists. In addition, we compare right and left radial access (RRA, LRA) in order to provide an insight into the clinical applicability of either side.

History

In 1940, Cournand and colleagues developed techniques for left and right heart catheterization; later in the 1960s, Judkins perfected the technique of CA via the femoral route by introducing more developed catheters.[6] In 1979, Gruentzig et al[7] presented the results of the first series of patients undergoing percutaneous CI, and in 1989, Campeau[8] published the first series of patients having CA via TRC. In 1995, Kiemeneij et al[9] conducted a study of TRC for CI using 6 French sheaths, yielding a procedural success of 98%. In 2001, Campeau[10] reported that TRC was used in almost 44 countries, and described TRC as beneficial compared to other approaches, with easier and safer postprocedural hemostasis, better patient comfort, early ambulation, along with the possibility of performing the procedure on an outpatient basis.

Methods

A comprehensive review of the literature was conducted. A Scopus and MED-

LINE/PubMed search was performed, using the terms "transradial catheterization", "radial catheterization", "right radial", "comparison", "left radial", along with the use of pertinent Pubmed "Related Articles"; 480 articles were identified, and 80 relevant articles, including 17 reviews. were selected.

Transradial catheterization, state-of-the-art

Campeau[10] suggested that TRC should be adopted as the default catheterization approach for the majority of patients. Currently, TRC is becoming increasingly popular[11] and everyone has his own access site preference, whether RRA or LRA;[12] however, both sides were found to have common ground.[13] With TFC, vascular access incidents range from simple to severe complications (hematoma, bleeding, thrombosis, fistula, dissection, aneurysm, pseudoaneurysm, peripheral emboli, etc.); these complications may require subsequent surgical intervention, with considerable morbidity/mortality and economic costs.[14] TRC reduces the risk of vascular access complications and yields a good clinical outcome,[15,16] although it may require greater technical skills.[17,18] Table 1 summarizes the main studies cited in this section.

Patient preparation and education

Patients are adequately informed of the procedure details, including potential complications, to ensure their better cooperation and compliance. During the procedure, patients are asked to immobilize their hand and wrist as a safety measure, though sometimes the hand is immobilized via a dedicated strap. Patients are instructed to inform the healthcare team of any severe pain or other unusual symptom during or after the procedure, so that the case may be assessed and the condition managed accordingly. An intravenous line

Table 1. Transradial (TRC) versus transfemoral (TFC) catheterization. List of recent main studies.

Author	Year	Design/patients	Issue/outcome
Mitchell et al	2012	Review / 14 studies	Cost benefit analysis of TRC
Jolly et al	2011	Randomized (RIVAL)/7021 pts	TRC vs. TFC for CA and CI in ACS
Bertrand et al	2010	Retrospective survey	International survey on TRC
Nathan et al	2012	Review	TRC vs. TFC for CI; vascular complications
Jolly et al	2009	Review/meta-analysis	TRC vs. TFC; impact on bleeding and ischemic events
Brueck et al	2009	Randomized, original/1024 pts	TRC vs. TFC for CA and CI
Dandekar et al	2012	Review	Complications of TRC
Agostini P et al	2004	Review/meta-analysis, 12 randomized studies/3224 pts	TRC vs. TFC for CA and CI
Dahm et al	2010	Review	TRC; technique, materials and anatomical variations
Chandarana et al	2010	Review	TRC; anatomical considerations; CI
Okuyan et al	2012	Original/35 pts	Effect of TRC on vascular diameter/endothelial function
Yan et al	2008	Original/103 pts	Safety and feasibility of TRC for CI in elderly with AMI
Vorobcsuk et al	2009	Review/meta-analysis, 12 studies/3324 pts	TRC superior to TFC in AMI
Mamas et al	2012	Review/meta-analysis, 9 randomized trials/2977 pts	TRC superior to TFC in STEMI
Mehta et al	2012	Original randomized/7021 pts	Decreased mortality in STEMI pts with TRA compared to TFA; no difference observed in Non ST elevation ACS
Romagnoli et al	2012	Original randomized (RIFLE-STEACS)/1001 pts	TRC superior to TFC in ST elevation ACS; lower mortality
Deftereos et al	2011	Original/98 pts	TRC as first choice and default route for PCI
Jia et al	2010	Original/1427 pts	Incidence and predictors of radial artery spasm
Wu et al	2011	Original/85 pts	TRC for chronic total occlusion
Sanmartin et al	2006	Original/304 pts	TRC of coronary bypass grafts, comparison with TFC
Mamarelis et al	2010	Case report	Radial artery angioplasty after perforation
Pancholy et al	2008	Original randomized (PROPHET)/436 pts	Patent hemostasis and radial artery occlusion

ACS – acute coronary syndrome; AMI – acute myocardial infarction; CA – coronary angiography; CI – coronary intervention; STEMI – ST-elevation myocardial infarction.

is placed on the side contralateral to the radial artery designated for catheterization and preprocedural sedation is prescribed on a case-by-case basis.

Anatomical considerations

Adequate anatomical information about the arterial bed, especially radial artery variations, is essential in order to avoid and overcome technical difficulties. According to Dahm et al,[19] access failure is reported in up to 7% of cases and is often related to puncture failure, radial spasm or anatomical anomalies. The ulnar artery predominantly forms the superficial palmar arch, with a contribution from the superficial palmar branch of the radial artery, whereas the radial artery predominantly forms the deep palmar arch.[20] Anatomical variations of the upper limb arteries are not rare and may occur at any level on the radial-brachial-axillary-subclavian axis (tortuous configurations, stenosis, hypoplasias, ectopic origin of the radial artery, radioulnar loop).[20,21] However, since procedural success in experienced centers is reported to be up to 98%, anatomical variations do not represent an important limitation to TRC.[21]

Structural and functional effects

Heiss et al[22] found that endothelial-dependent vasodilation is impaired in the radial and brachial arteries when measured 6 hours after TRC; interestingly, brachial artery functional impairment was related to the number of catheters used. Similarly, Madssen et al[23] reported that the radial artery diameter was still diminished 1 year following TRC at baseline, and after the administration of vasodilatory drugs. These structural and functional changes should be taken into consideration when a previously catheterization-exposed radial artery is to be re-used for TRC.

Cost-effectiveness

TRC allows easier and safer hemostasis at the entry site, along with early ambulation that is compatible with an outpatient procedure. Theoretically, the decrease in postprocedural complications and the shorter hospital stay should lead to a reduction in healthcare expenses.[16] Jolly et al[15] reported a lower morbidity with TRC compared to TFC, along with a reduction in hospital stay by 0.4 days per case. Mitchell et al[1] conducted a meta-analysis and applied a stochastic simulation, including baseline costs and costs of potential complications. Under all conditions tested, TRC was found to cost at least $275 less per patient when compared to TFC.

Acute coronary syndrome

Yan et al[24] reported that CI via TRC is safe and feasible in elderly patients with acute myocardial infarction. Other authors[25,26] showed that CI via TRC in ST-elevation myocardial infarction, when compared to TFC, significantly reduces periprocedural bleeding and major adverse events, including cardiac death, myocardial infarction, and stroke. Similarly, Mehta et al[27] reported a reduction in morbidity/mortality in patients with ST-elevation myocardial infarction when CI is performed via TRC (versus TFC). Importantly, such benefits were not found in patients with non ST-elevation acute coronary syndrome. Likewise, Romagnoli et al[28] reported that CI via TRC in patients with ST-elevation acute coronary syndromes is associated with both lower morbidity and cardiac mortality. Accordingly, TRC for CI is recommended as the gold standard approach in ST-elevation myocardial infarction, provided adequate operator expertise is available.[28,29]

Outcomes

TRC for CI has proven to yield a lower morbidity/mortality[27,28] in patients with ST-elevation myocardial infarction; it also yields better patient comfort, a shorter hospital stay, and better cost-effectiveness, along with a decrease in access-site complications.[1,15] It is important to note that staff education is critical for the correct implementation of an efficient TRC program, in order to ensure improved procedural outcomes along with maximum patient safety and satisfaction.[18]

Procedural duration and operator radiation exposure

Many authors have reported that TRC is associated with an increase in operator radiation exposure;[30,31] Brasselet et al[32] also reported that patients' exposure is significantly higher with TRC compared to TFC. However, other authors[33,34] interpreted these previously cited reports with extreme caution because of their possible biases: low- to moderate-volume centers, still being on the learning curve, the non-randomized nature of some studies, and a lack of information regarding the condition of the cine-angiography systems; moreover, there was no mention of whether TRC was performed via RRA or LRA.

Installing a TRC program and learning curve

Installing a TRC program requires both administrative support and operator determination, along with staff education.[35] Nursing and technical staff must develop a structured program to provide the patient with all the necessary care and education, and the program must involve both didactic and practical learning. In addition, staff proficiency in removal of the hemostasis band is necessary, along with recognition of potential local complications. Operators are advised to start their learning period with selected cases and preferably in a non-emergency setting, especially if no mentor is supervising the process.[2] Any difficulties encountered must be recorded systematically and a management chart constructed accordingly. Pre-procedural preparation is essential to prevent radial artery spasm. A gentle approach to the patient is also important, and both the patient and the operator must feel comfortable during the procedure.[20] A thoughtful problem-solving approach is the key to overcoming potential technical difficulties and achieving a high success rate, TRC theoretically requires higher technical skills compared to TFC, and it requires a "secondary" learning curve of at least 100 cases in order to gain adequate expertise.[19,36]

Technical issues, tips, and tricks for successful TRC

"Graceful" operator hands contribute significantly to successful TRC. "Graceful" hands are dependent upon the operator's inherent personality and talent, but are also acquired and developed with experience; moreover, "graceful" hands must be commanded by a "thoughtful" mind, synchronized for a better clinical outcome.[19]

Patient preparation is started in the pre-catheterization unit; pre-procedural sedation helps to prevent radial artery spasm related to fear or pain and is given at the discretion of the operator on a case-by-case basis. The patient's forearm should be stabilized on a dedicated board or cradle; a wrist-hand angle of approximately 60 degrees may facilitate the palpation of the radial pulse; first puncture success is essential to prevent radial artery spasm and other local complications.[37] Local anesthesia should be minimal and smooth—any abusive manipulation may lead to radial artery spasm, while "high" volume subcutaneous xylocaine may hide radial artery pulsations. Arterial pulsations may decrease or disappear after local anesthesia, so that relocating the radial artery is necessary before inserting the puncture needle. When radial pulsations are weak at baseline, it is better to perform the needle puncture—after advising the patient—without local anesthesia, then to apply local anesthesia before introducing the sheath.[19] Direct needle puncture has the advantage that it facilitates accurate puncture even when radial pulsations are weak; puncture with over-the-needle catheters may not give the same accuracy as direct needle puncture.[19]

The classical catheterization set contains primarily a needle, a sheath, and a guidewire; the needle is inserted at an approximate angle of 30-45°. Testing the hand's collateral circulation (Allen test) is not performed consistently throughout the world; it is performed in nearly 85% of cases in the U.S.[4] The type of catheter is left to the discretion of the operator; however, the diagnostic and guiding-catheters used for TRC are mostly similar to those used for TFC and the use of specialized radial catheters is rare.[4] In order to decrease the risk of radial artery spasm, a spasmolytic cocktail (verapamil +/- nitrate) is given intra-arterially. Heparin remains the routine antithrombotic agent used in the world,[4] although intra-arterial low molecular heparin (enoxaparin) can be given;[38] it is better to inject the antithrombotic agent only when the guidewire reaches the aortic arch, taking into consideration the potential need to make a crossover to TFC.

Good preparation and proficient knowledge of the anatomic variations are essential in order to overcome technical difficulties related to radial spasm or to atypical vascular anatomy. In case of blockage of the guidewire, smooth "backward-forward" maneuvers may help to cross some difficult passages. Catheter introduction and progression from the distal radial artery to the aortic arch must be smooth; any resistance to catheter advancement can be checked by dye injection (check shoots) when necessary. Using a hydrophilic guidewire and asking the patient to breathe deeply are helpful in overcoming vascular tortuosity or acute angles, though coronary guidewires or guidewires with a steerable tip may be required in rare cases. Guidewires with variable stiffness may be needed when additional support is required to enhance coronary cannulation.

Special procedures

The radial artery is a small vessel; nonetheless, it can accommodate devices for complex procedures (bifurcation angioplasty, intravascular ultrasound, rotational atherectomy, etc.).[2,39] Cheaito et al[40] reported on the successful use of a sheathless guiding catheter for the treatment of coronary bifurcation lesions via TRC. Wu et al[41] reported an 87.1% success rate in the treatment of chronic total occlusion lesions via bilateral TRA, without major complications. Gioia et al[42] reported a 94% success rate for rotational atherectomy using 7 Fr guiding catheters via TRC. Sanmartin et al[43] reported that TRC of coronary bypass grafts is feasible with a high success rate and without a significant time delay compared to TFC. Several reports[44-46] showed that left internal mammary angiography and angioplasty are feasible and safe via RRA, though this technique requires experienced operators and sometimes dedicated catheters (5 Fr Yumiko;[47] Simmons[48]). Rondán et al[49] reported performing CA and CI via RRA using a single catheter (Judkins left 3.5) with a success rate of 94%. Similarly, Kim et al[50] reported on the use of the Tiger II as a multipurpose catheter for CA of both right and left coronaries via RRA, with a success rate of 100%, and without any clinical or angiographic complications. Finally, Youssef et al[51] reported the use of a single transradial guiding catheter (Ikari Left 6 Fr) for CI with a procedural success of 98.2%.

Right radial versus left radial access

A recent international survey[4] showed that RRA is used in nearly 90% of cases in the world, whereas LRA is used in almost 10% of cases. Herein we describe and assess the benefits and the potential limitations encountered when using RRA and LRA; we also present an insight into the clinical applications of each side. TRC is already recognized as beneficial compared to TFC, whether implemented via RRA or LRA.[52] Nevertheless, many reports[53-55] have questioned whether one side (RRA versus LRA) is advantageous over the other, especially if TRC is destined to become the default access route or gold standard.[36,56] Santas et al[57] reported in 2009 that RRA and LRA have similar success rates and procedural durations; however, there are other variables that depend on whether TRC is implemented via RRA or LRA, particularly the vascular anatomy, learning curve and success rate, radiation exposure and the risk of cerebral complications. Table 2 summarizes the main studies cited in this section.

Anatomy

There is an anatomical disparity between the two access sides: LRA involves fewer catheter curvatures compared to RRA, implying that the coronary arteries are theoretically engaged more "easily" via LRA compared to RRA.[56] Velasco et al[58] reported that the average right radial artery diameter is 2.22 ± 0.35 mm, while female patients had a smaller radial artery diameter. Interestingly, the same investigators found that a high body mass index is associated with a larger radial artery diameter. The radial artery is mainly a muscular artery, with a prominent medial layer rich in α-1 adrenoreceptors. This micro-anatomy explains the high rate of radial artery spasm. However,

Table 2. Right (RRA) versus left (LRA) radial access. List of recent main studies.

Author	Year	Design/patients	Issue/outcome
Chugh SK	2009	Review/consensus	Consensus; RRA vs. LRA
Santas et al	2009	Original randomized/1005 pts	Comparison TFC, LRA and RRA
Kawashima et al	2004	Original/437 pts	Effectiveness; RRA vs. LRA
Dominici et al	2013	Original randomized (OPERA)/413 pts	X-ray exposure; RRA vs. LRA
Sciahbasi et al	2011	Original (TALENT-substudy)/390 pts	Operator X-ray exposure; RRA vs. LRA
Pelliccia et al	2012	Original (PREVAIL) /509 pts	Effectiveness; RRA vs. LRA
Sciahbasi et al	2011	Original randomized (TALENT) /1540 pts	Procedure times; radiation exposure; RRA vs. LRA
Dominici et al	2012	Original/1032 pts	Effectiveness, fluoroscopy time; RRA vs. LRA
Freixa et al	2012	Original/100 pts	RRA vs. LRA; in octogenarians
Norgaz et al	2012	Original randomized/1000 pts	Effectiveness, fluoroscopy time; RRA vs. LRA
Larsen et al	2011	Original/135 pts	effectiveness, STEMI; RRA vs. LRA
Kanei et al	2011	Original randomized /193 pts	Randomized comparison; RRA vs. LRA
Sciahbasi et al	2011	Original randomized/1540 pts	Learning curve; RRA vs. LRA
Biondi-Zoccai et al	2011	Review/meta-analysis 5 trials/3210 pts	Comparison; RRA vs. LRA
Fernandez-Portales et al	2006	Original/351 pts	Learning curve; RRA vs. LRA
Pacchioni et al	2012	Original/40 pts	Micro-emboli to brain; RRA vs. LRA

STEMI – ST-elevation myocardial infarction; TFA – transfemoral access.

we did not identify any study that reported any difference between RRA and LRA regarding the incidence of spasm. Kawashima et al[59] reported severe tortuosity of the right subclavian artery and brachiocephalic trunk in nearly 10% of cases; this finding may lead to additional catheter manipulations and exchanges when using RRA. Notably, we did not identify any study that reported whether the right radial artery was slightly larger than the left radial artery in right-handed subjects, although theoretically this hypothesis is compelling.

Procedural duration and radiation exposure

The OPERA study[60] found that LRA is associated with a lower radiation dose absorbed by the operator compared to RRA, whereas fluoroscopy time was similar; likewise, a TALENT sub-study[61] found that LRA is associated with a lower radiation dose for operators at the wrist. The PREVAIL study[62] found that LRA is associated with a shorter procedure time and lower radiation exposure compared to RRA, and this finding was independent of the operator's proficiency. Similarly, other reports[63,64] found that LRA is associated with a shorter fluoroscopy time and a lower radiation dose absorbed by patients when compared to RRA.

However, LRA is not always associated with lower radiation exposure. Pristipino[33] reported that when the operator is standing on the right side of the patient for an LRA procedure, the operator's forearm and wrist are sometimes beyond the leaded glass, which may lead to increased radiation exposure. In octogenarians, Freixa et al[65] did not find a significant difference in procedural and fluoroscopy times between RRA and LRA. The amount of contrast material delivered actually depends on the operator proficiency and procedural duration; current data[59,61] do not support any significant difference between LRA or RRA in the contrast amount used. However, Kawashima et al[59] reported that LRA is associated with fewer catheter manipulations, and shorter procedural and fluoroscopy duration. It should be noted that tortuosity of the right subclavian artery was encountered frequently in this study; this may prolong the procedure duration during RRA, independently of the operator's proficiency. Finally, Norgaz et al[66] reported that LRA for CA is associated with the same success rate and procedural duration compared to RRA; however, fluoroscopy time was significantly shorter for the LRA.

ST-elevation myocardial infarction

Larsen et al[67] reported that percutaneous CI in the setting of ST-elevation myocardial infarction had similar total procedural time, success rate, and safety whether performed via RRA or LRA. In addition, there was no significant difference regarding room-to-cannulation time or room-to-balloon time, nor was any significant difference found in procedure-related complications or death.[67]

Success rate and learning curve

Kawashima et al[59] reported that the rate of guidewire use to engage the coronary ostium was higher with RRA compared to LRA. Kanei et al[68] defined procedural difficulty as one (or many) of the following: use of hydrophilic wire, use of stiff wire for coronary engagement, use of multiple catheters, nonselective injection. The same authors conducted a randomized comparison between RRA and LRA in a series of patients who had no history of coronary artery bypass, and found that procedural success and difficulty were similar in both groups; interestingly, the investigators noted that the use of a dedicated single radial catheter for TRC was more frequent with RRA. Many authors[57,64] reported no difference in success rate or procedural duration between RRA and LRA, nor any difference in major adverse events—though the number of catheters used was reported to be higher with RRA. Sciahbasi et al[69] compared the procedural duration over time when operators were still on the learning curve and found a progressive reduction in cannulation time after 200 cases, whether performed via RRA or LRA. Interestingly, the authors reported that the learning curve was shorter for LRA. Biondi-Zoccai et al[70] conducted a large meta-analysis comparing RRA and LRA and concluded that both approaches have similar success rates; however, LRA was recommended for operators who are still on the learning curve. Fernández-Portales et al[71] also recommended LRA during the learning curve; notably, the investigators found that RRA, lack of catheterization experience, and age over 70 years were independent factors for procedural failure.

Complications of TRC – RRA versus LRA

The failure rate of TRC ranges from 3-7% and access failure is often related to puncture failure, radial artery spasm, or anatomical abnormalities.[17,19]

Radial artery spasm

This is a relatively frequent complication, is reported in up to 10% of cases, and is related to the presence of a prominent medial layer rich in α-1 adrenoreceptors; accordingly, high levels of circulating catecholamines due to the patient's discomfort and pain may easily trigger radial artery spasm.[72,73] Jia et al[37] found that female gender, diabetes, small radial artery diameter, and multiple punctures were independent predictors of radial artery spasm. Kristić et al[73] reported that the incidence of radial artery spasm was reduced to around 3.8% by the intra-arterial administration of spasmolytics. Ruiz-Salmerón et al[74] found that postprocedural pain in the forearm is more frequently encountered when periprocedural radial artery spasm is reported. Riekkinen et al[75] reported that the right radial artery is more frequently the dominant forearm artery compared to the left radial artery (in right-handed subjects?), extending this data to consider the hypothesis that the left radial artery could be more prone to spasm than the right—although we could not identify any study that supported this hypothesis.

Radial artery occlusion

This is usually a silent complication. It is probably underestimated because of the lack of consistency in the methods of assessment of radial artery patency: a simple pulse check at the site of cannulation is not always reliable.[76] Furthermore, it has been reported that radial artery patency is not assessed before discharge in nearly 50% of cases.[4] Acute occlusions are caused by intraluminal thrombosis and occur within 48 hours post TRC, whereas subacute occlusions (up to one month post TRC) are rather related to intima–media remodeling with subsequent thrombosis.[76] The value of the Allen Test is debatable:[77] nevertheless, it allows an evaluation of the collateral perfusion of the hand, and when the test is abnormal or doubtful, a modified Allen test using oximetry is helpful (Barbeau test).[78] Occlusive hemostasis and inadequate anticoagulation are predictors of radial artery occlusion.[76] Pancholy et al[78] (PROPHET) reported that patient hemostasis is a critical issue for the prevention of radial artery occlusion. We did not identify any study that showed a difference between RRA and LRA regarding the incidence of radial artery occlusion. In order to prevent radial artery occlusion, the operator should proceed with smooth manipulation to prevent endothelial trauma and apply guided compression to prevent occlusive hemostasis, along with adequate anticoagulation.[69] Many transparent devices available in the market allow guided compression for patent hemostasis along with visual assessment of the access site.

Cerebral emboli

Pacchioni et al[79] reported that RRA involves a larger number of catheter exchanges and maneuvers, and this was found to be an independent predictor of micro-embolic brain signals. Importantly, Kawashima et al[59] reported severe tortuosity of the right subclavian artery in nearly 10% of cases, leading to additional catheter manipulation and exchange. In addition, Dahm et al reported that the brachiocephalic trunk passage is a critical moment during RRA and may represent the origin of cerebral emboli.[19]

Other complications

Dominici et al[64] did not find any significant difference between RRA and LRA regarding major in-hospital cardiac and cerebral events. Other complications of TRC have been reported for both approaches (RRA and LRA). They may consist of forearm hematoma, radial stenosis (segmental or diffuse),[56] major bleeding, and arterial perforation (or avulsion), which are highly morbid complications.[17] Mamarelis et al[80] reported a case of radial artery angioplasty after inadvertent radial perforation. In order to prevent such adverse events, smooth catheter manipulation is essential, also an extensive knowledge of anatomical variations is important.

Clinical insights and implications – rationale of TRC, RRA or LRA

There is a logical rationale for implementing TRC as the default catheterization access: fewer local complications, better cost-effectiveness, more patient comfort, shorter hospital stay, and lower mortality in ST-elevation acute coronary syndromes. Good patient preparation and adequate operator expertise are critical for the prevention and appropriate management of complications. Smooth catheter manipulation, along with spasmolytic drugs, are essential to prevent radial artery spasm; in addition, patent hemostasis and adequate anticoagulation are important factors for decreasing the risk of radial artery occlusion. A previously catheterized radial artery exhibits anatomical and functional remodeling; this issue has to be taken into consideration when re-catheterization on the same side is planned.

There are anatomical differences between RRA and LRA. RRA should be avoided in elderly patients when practitioners are still on the learning curve, and in acute clinical settings; patient selection is also essential when operators proceed in the absence of a mentor. In all cases, a gentle and smooth approach, along with extensive knowledge and thoughtful problem solving are key to achieving a successful TRC program, whether implemented via RRA or LRA. When all these issues are taken into consideration, RRA and LRA find common ground (and East meets West, via Turkey).[13]

Conclusion

TRC is increasingly being implemented worldwide and is associated with better clinical outcomes compared to TFC. The benefits of TRC, which include near-zero access site complications, staff convenience, early patient ambulation, and lower mortality in ST-elevation acute coronary syndrome, are now clearly documented. RRA and LRA have roughly the same outcomes, though RRA is technically more challenging and may be associated with higher radiation exposure compared to LRA. In addition, the learning curve of RRA is longer than that of LRA. In the future, TRC is expected to be used for increasingly sophisticated procedures; medical schools and teaching hospitals worldwide should focus on teaching TRC so that cardiologists start the learning curve early. Interventional cardiologists over the world should become "radialists", so that patients everywhere can benefit from this efficient and elegant technique.

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