

Developing a Transradial Cardiac Catheterization and Intervention Program

Practical considerations important for implementing radi(c)al change.

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Despite the mounting evidence supporting the various advantages associated with the transradial approach, United States operators and training programs have been relatively slow in adopting this technique compared with the rest of the world.^{1,2} The reasons for such are myriad and likely include a lack of formalized training, a reluctance to adopt novel techniques that may interrupt daily operational case flow or challenge entrenched institutional beliefs, the ingrained attitudes of the support staff, and the need to invest in new equipment. Further up front issues to consider include relatively longer procedural times and the associated extra radiation exposure experienced while achieving technical proficiency. An initially high rate of crossover to femoral access should be expected as well.

Depending on the local attitudes and environment, these issues require intensive commitment and effort by both operators and laboratory staff. However, once the initial steps of this transition are negotiated, the benefits in regard to procedural safety, improved lab and recovery area throughput, more efficient allocation of support staff resources, and enhanced patient satisfaction will quickly be realized.

The decision to transition to radial access may be made by individual operators or the administration of the cardiac catheterization laboratory, but invariably, the durable success of such a prospect is incumbent on all support staff embracing this change as well. As

such, the training of a few select personnel during the early phases of implementation may be easier. As the benefits in terms of postprocedural recovery become clearly evident, these staff members will be central in disseminating to colleagues the important care practices required for transradial access.³

EDUCATION AND TRAINING

A vital first step toward understanding the important practical, logistical, and technical aspects of implementing a transradial access program is learning from other established operators, particularly if there was a lack of exposure to this technique during fellowship training. A variety of educational 1- or 2-day transradial symposiums offered by professional organizations are offered quite frequently throughout the country. Additionally, useful web-based resources (ie, www.transradialuniversity.com, www.terumo.com, www.theheart.org, www.angioplasty.org, www.transradialworld.com) are available to facilitate an open dialogue between seasoned and new operators while also offering tutorials regarding the key aspects of patient preparation, equipment selection, and overcoming technical obstacles (ie, challenging radial anatomy such as radial loops, severe tortuosity of the innominate artery, arteria lusoria, etc).

A successful transition will also require all members of the cardiac catheterization team to be trained in the fundamental aspects of the radial approach. For exam-

ple, the nurses who prepare patients for transradial procedures need to be cognizant of several issues, one of which is avoiding placing intravenous lines near the proposed radial access site. If right heart catheterization is also required, an intravenous line in the ipsilateral antecubital vein will need to be placed and will be switched for an introducer sheath.

Procedural nurses will need to become accustomed to the key aspects of room preparation, including how to properly position the patient's arm; the use of newly designed dedicated drapes, arm boards, and sheaths for radial access; and preparation and administration of pharmacologic agents that are used to decrease radial artery spasm and occlusion (ie, antispasmodics, such as verapamil, nicardipine, or nitroglycerin, and anticoagulants such as heparin). Radial artery spasm may be further offset by the administration of adequate levels of procedural sedation that must be actively titrated by in-lab personnel.

X-ray technologists will need to learn slightly different variations in table positioning, particularly if difficult wire or catheter transit is experienced in the radial, brachial, or subclavian arteries. Staff dedicated to postprocedure recovery will need to be trained in access site management (in particular, the use of specially designed radial artery occlusion devices), as well as vigilantly monitoring for forearm hematoma and accurately appraising the safety of patient discharge or transfer to other wards.

The details crucial for total procedural success may best be assimilated through dedicated visits to fully functional transradial cardiac catheterization laboratories by operators and support staff alike, which will likely further reinforce the numerous potential benefits of the radial approach.

EQUIPMENT

The procurement of certain specialized equipment will greatly facilitate procedural success. First, in terms of patient preparation, dedicated arm boards or specially designed acrylic cradles are commercially available and provide an adequate workspace for the operators while ensuring patient comfort. Specialized radial hydrophilic sheath kits (Glidesheath, Terumo Interventional Systems, Inc., Somerset, NJ) equipped with access needles (usually 21 gauge or smaller) and capable of accepting various caliber wires (ie, 6-F compatible with a 0.035-inch wire) are fundamentally important as well. These sheaths are associated with less radial spasm, thus promoting safe extraction with less patient discomfort.^{4,5} Additionally, if initial attempts to achieve radial access prove unsuccessful, ultrasound-guided radial arterial puncture can be performed.

Although a number of novel catheters have been

designed to engage both the right and left coronary arteries, conventional Judkins catheters can be utilized with little difficulty or excess procedural cost. Due to the slightly elongated orientation that the Judkins left diagnostic catheter assumes from the right radial approach, the catheter size required is typically one half size smaller than that needed from the femoral approach (ie, Judkins left 3.5). Typically, no such adjustment is necessary with the Judkins diagnostic catheters for the right coronary artery. For labs exclusively dedicated to diagnostic procedures, a variety of 0.014-inch coronary guidewires and 4-F Glidescatheters will be vital pieces of equipment that, when used in conjunction, will help overcome important anatomical obstacles such as radial loops.⁶

More frequently, severe innominate artery tortuosity may make access to the ascending aorta difficult. This can be facilitated by advancing a 0.035-inch straight or J-wire while having the patient hold a deep inspiration, thereby elongating the thorax while simultaneously reducing the angle between the innominate and ascending aorta. If access to the ascending aorta proves challenging, it is essential that long J-wires (300 cm) are available for catheter exchanges.

TRANSITIONING TO RADIAL ACCESS

Clearly, implementing wholesale change in the catheterization lab requires a sustained multidisciplinary effort. As such, the prospect for success is incumbent on a commitment not only by the operators, but also the entirety of the support staff, including laboratory and recovery room nurses, technologists, and the administration. It is vital that early on, the expectations of other operators, support staff, and administrators be tempered. Higher rates of procedural failure, contrast use, and fluoroscopic time associated with this transition should not only be expected but also tolerated given the promise of future reductions in bleeding complications, improved patient comfort, lab throughput, and lower total costs associated with the transradial approach.⁷

With this in mind, it is imperative that those early patients specified for a transradial approach should solely consist of elective diagnostic cases with low likelihood for intervention. Additionally, these patients should be those in whom radial access and catheter engagement of the coronary arteries will be relatively simple. These patients include those who are relatively larger (ie, larger caliber radial arteries), are taller than 165 cm (ie, longer ascending aorta aids catheter engagement), are younger (less likelihood for significant upper arterial tortuosity), have normal renal function, and lack bypass grafts. Patients with suboptimal Allen's test results, arteriovenous fistulas, Raynaud's phenomenon, or known pathology of the subclavian or

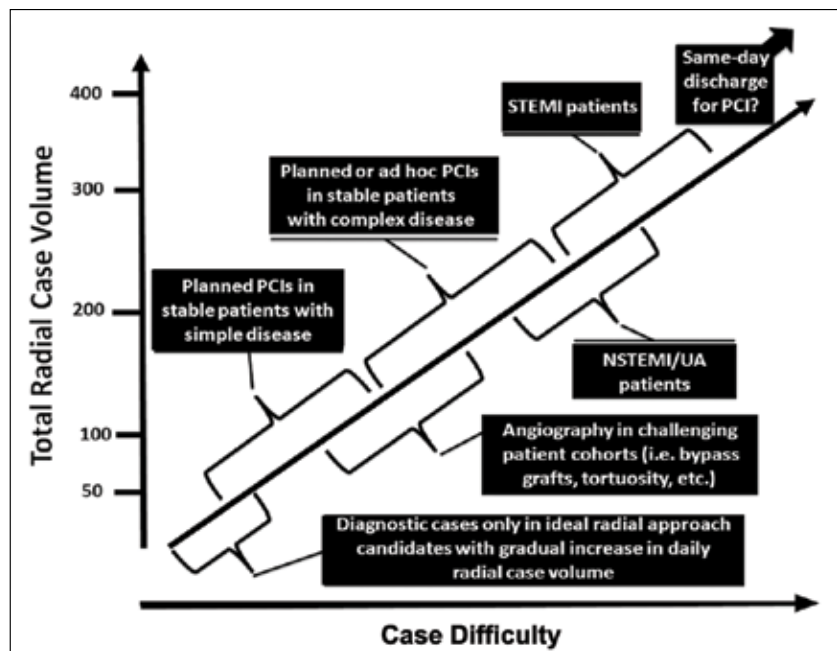


Figure 1. Critical case milestones toward achieving transradial competency.¹⁰ The initial 50 cases for transradial access should be composed of those diagnostic cases with a low likelihood for intervention but a high likelihood for procedural success. As experience and confidence accrue, patients specified for transradial procedures should be expanded to those of incrementally increasing complexity and likelihood for PCI. As laboratory and operator efficiency improves, planned or ad hoc PCI of increasingly complex disease in patients with more comorbid illness can then be performed. Complete proficiency allows for emergent transradial PCI for ST-elevation myocardial infarction to be performed safely without compromising door-to-balloon times, procedural success, or clinical outcomes. The prospects for a same-day discharge program after uncomplicated PCI could also then be considered.

innominate arteries should be avoided at this time.

Left radial access should be considered for these initial cases because the technical maneuvers required for successful coronary engagement closely approximate that of the femoral approach, greatly smoothing the general transition for both operators and support staff alike. Additionally, on-site proctoring by visiting operators can be instrumental. However, as the number of transradial cases performed increases, operator skill and confidence grow, and with a relatively low number of cases (approximately 100 cases), the procedural success rate of new radial operators closely approximates that of operators with more experience and higher volume.⁸

An articulated plan to incrementally expand daily radial case volume should be implemented as well. Specifically, one case per day should be attempted initially, with a gradual increase to two and later three cases per day when the total radial procedures performed reaches 15 and then 30 cases, respectively. This is an important consideration

because an abrupt (rather than gradual) change to radial access will likely result in significantly lower laboratory efficiency initially, thereby increasing operator and staff frustration while dampening overall enthusiasm for the endeavor as a whole. However, with increased proficiency, patient selection criteria for transradial access can be broadened to include patients scheduled for relatively simple, planned percutaneous coronary intervention (PCI) procedures and later, those of incrementally increasing complexity (ie, patients who are older, anticoagulated, or with bypass grafts, etc.).

Experience and increasing comfort with transradial PCI will lead to its continued expanded application in higher acuity patients (ie, PCI for non-ST-elevation myocardial infarction, multivessel disease, left main or left main equivalent, vein grafts, low ejection fraction, adjunctive rotational atherectomy, etc.). At this point, transradial access will likely have become the default access strategy employed, enabling successful transradial PCI for ST-elevation myocardial infarction without compromising door-to-balloon time. As radial access continues to

predominate as the access site of choice, same-day discharge after PCI, a practice still under investigation, could be implemented.⁹ The learning curve and suggested case milestones toward achieving transradial proficiency are depicted in Figure 1.

CONTINUED COMMITMENT AND QUALITY IMPROVEMENT

Increased patient satisfaction, primarily derived from a lower rate of bleeding and vascular complications, earlier ambulation, and greater comfort, will likely reinforce the use of the transradial approach, leading to a greater number of referrals and increased case volume. Clearly beneficial in many respects, ongoing monitoring of important indices (including the overall rates of a priori transradial versus transfemoral procedural volume, radial access failure [crossover rate], and complication rate) will be critical to ensuring a continued

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commitment to transradial PCI that is not only appropriate but exceedingly safe. Routine case review conferences with colleagues about particularly challenging transradial cases or those associated with radial access failure will be essential for intensive practice improvement as well.

CONCLUSION

In comparison with the United States, the world has adopted the transradial approach as the default strategy for both cardiac catheterization and PCI. The initial enthusiasm for this technique in the United States has largely plateaued, as transradial rates remain stably low. To remedy this situation so that more operators and cardiac catheterization laboratories may realize the salient benefits associated with the transradial approach, dedicated hands-on workshops, didactic sessions, and web-based resources sponsored by both industry and professional societies are now available. As the incremental benefits attributable to novel procedural and pharmacologic innovations related to PCI diminish, the more widespread use of transradial access may help to substantially improve clinical outcomes and quality of care. ■

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