Radial Access for Structural Intervention

A transradial approach can be utilized as a primary or secondary access strategy to reduce morbidity and major adverse cardiac events in various structural interventions.

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In 2016, the debate over the safety and efficacy of radial access (RA) for cardiac catheterization and interventional procedures is pretty much settled. In a recent comprehensive, strong meta-analysis of randomized controlled trials, it was concluded that, when compared with femoral access (FA), RA reduces mortality and major adverse cardiac events and improves safety by reducing major bleeding and vascular complications across the entire spectrum of patients with coronary artery disease.1,2 With expanded understanding, improved techniques, and technology, the use of RA is extending to endovascular peripheral artery disease intervention and structural intervention (SI).3,4 There have been 18 reports/studies between 2002 to 2015 evaluating the utility of RA, either as primary or secondary access in transcatheter SI.4 Although the FA complications ranged from 0.16% to 40%, with an overall incidence of 2.2% (56/2,521 patients), the overall incidence of RA complications was 0.5% (2/406 patients) with no major vascular or bleeding complications.

We have used RA and/or arm vein access (AVA) (basilic or cephalic) either as primary access for alcohol septal ablation (ASA), paravalvular leak (PVL) closure, ventricular septal defect (VSD) closure, right ventricle myocardial biopsy, or physiologic evaluation of valvular heart disease. We have also gained extensive experience in using RA and/or AVA as secondary access for transcatheter aortic valve replacement (TAVR), patent ductus arteriosus closure, and endovascular repair of abdominal or thoracic aneurysm. Herein, we describe the potential role of RA and AVA for some of the SI procedures, although discussing the technical details, advantages, and limitations of RA for each of these procedures is beyond the scope of this article.

ASA

A recent publication from a single-center retrospective review concluded that ASA from the radial approach could be performed with similar acute and long-term success, but with lower vascular complications compared to the femoral approach.5 This procedure is in very close simulation to transradial (TR) coronary intervention. The transvenous pacer can be used either from the AVA or neck vein (jugular/subclavian) approach. In an example shown in Figure 1, a 63-year-old man was treated for symptomatic, hypertrophic, obstructive cardiomyopathy. Right basilic vein access was used to place a transvenous balloon tip pacing catheter. Right RA and a dual-lumen, multipurpose shape Langston catheter (Vascular Solutions, Inc.) was used to measure the gradient across the left ventricular (LV) outflow track before and after septal ablation. The first septal artery ablation was performed using an extra backup 3.5-F guide catheter and injecting 2 mL of alcohol.
EVALUATION OF SEVERE AORTIC STENOSIS

A complete left and right heart catheterization (RHC), including measurement of the transvalvular gradient, may be necessary to assess the hemodynamic severity of aortic stenosis (AS) if there is a discrepancy between clinical and echocardiographic data or for evaluation of patients with low-flow/low-gradient AS and LV dysfunction. Elderly patients suffering from AS, particularly women, are at the highest risk of vascular access complications when FA is used. On the other side, RA might be challenging because of the high prevalence of tortuosity in elderly patients.

Also, the most important independent predictor of silent cerebral infarction during retrograde crossing of the aortic valve is the time required for crossing the aortic valve. We published a cross-sectional analysis of 234 patients who underwent either TR (n = 58) or transfemoral (TF) (n = 176) catheterization for evaluation of severe AS (valve area < 1 cm$^2$). Although the fluoroscopy time, time to cross the aortic valve, and incidences of cerebrovascular events were similar in both groups, the access site complications were significantly higher in the TF group compared to the TR group (5.11% vs 0%; $P < .005$). Therefore, TR retrograde crossing of a severely stenosed aortic valve is not only feasible using the usual equipment, but also reduces access-related complications.

RA FOR VASCULAR ACCESS MANAGEMENT DURING TAVR

RA can be used as a secondary access for performing aortography during TAVR procedures, as well as for vascular access management for the large-bore FA. A study evaluated 41 TF TAVR procedures that used contralateral FA as secondary access and 46 TF TAVR procedures using RA as secondary access. Procedural radiation dose and fluoroscopy times were comparable. At 30 days, all-cause and cardiovascular death were statistically non-significant between the radial and femoral groups (2.4% vs 7.9%; $P = .258$ and 0% vs 7.9%; $P = .063$, respectively). Stroke and myocardial infarction rates were similar between the RA and FA groups (2.4% vs 5.6%; $P = .481$ and 2.6% vs 2.8%; $P = .954$, respectively). There were non-significant but lower major vascular complications (4.3% vs 7.3%; $P = .553$) and life-threatening bleeding events (9.1% vs 19.5%; $P = .168$) in the RA group in comparison to the FA group. The study concluded that RA for vascular access management during TAVR is a safe and effective alternative to FA.

In an example shown in Figure 2, a multipurpose catheter was inserted via RA into the right iliac artery. Subsequently, a 9-mm balloon was inflated in the external iliac artery while the 14-F sheath was removed and sutures were harvested from the preclose closure device and tied to achieve hemostasis without significant bleeding.

AORTIC PVL CLOSURE

Endovascular closure of PVL using vascular plugs is reported to have high success rates in treating severe aortic regurgitation. Although the femoral approach remained the access of choice, we recently reported our experience of using RA in five out of 13 patients who underwent transcatheter PVL closure in the last 3 years. The overall procedure success was high, regardless of the access used. In one patient, we were required to switch from FA to RA after multiple unsuccessful efforts to cross the PVL with a 5-F sheath or 6-F guide catheter, which led to a successful PVL closure. Understanding the technique...
and having knowledge of another approach can allow success, as the wire in the paravalvular space may behave differently against the frame of the valve through RA in comparison to FA. As shown in Figure 3, right RA was used to treat two PVLs (anterior and posterior) with transesophageal echocardiographic guidance.

VSD CLOSURE
After the early description in 2002, percutaneous techniques and devices have been developed overtly for the closure of perimembranous VSD. Traditionally, femoral artery and vein access or jugular access have been used for VSD closure, but we reported a case of percutaneous closure of a perimembranous VSD through an arm approach (RA and basilic vein) (Figure 4). In our experience, crossing a high perimembranous VSD is quite easy from the RA approach using a JR 4 catheter and an angled, torqueable 0.035-inch wire. Although the access-related complications from femoral artery, femoral vein (FV), or internal jugular (IJ) vein access are arguably low, RA and basilic vein access may offer a safer access, or at least provide another alternative, particularly when access choices are limited.

In other instances, we have used a combination of radial artery and FV access or a combination of FA and AVA that can be customized for the anatomy of each individual patient (Figure 5). With the miniaturization of the device profile to a 12-mm diameter, the Amplatzer VSD occluder (St. Jude Medical, Inc.) can be deployed through a 7-F sheath. The basilic vein access is preferred over cephalic vein access. Ultrasound guidance or the levo-phase technique can be used to determine a fairly large superficial basilic vein. As the veins expand, a sheath (> 7 F) can be used through the basilic vein in appropriately selected patients, which will allow the use of a large VSD occluder.

MYOCARDIAL BIOPSY VIA AVA
RHC and endomyocardial biopsy are common procedures for patients with heart failure, heart transplantation, and for the diagnosis of infiltrative myocardial disease. IJ or FV accesses are predominantly used for these procedures. A retrospective study performed comparative analyses between the RHC and biopsy performed via neck vein (594 cases) versus AVA (141 cases). Procedural complications were low (n = 7; 0.6%) and were only associated with the neck approach. Patients surveyed preferred the arm approach. The study concluded that RHC and endomyocardial biopsy through the brachial vein could be performed safely, timel, effectively, and

Figure 4. LV angiography showing perimembranous VSD (A). Using a JR 4 catheter from the right RA, a hydrophilic wire was crossed through the VSD into the right ventricle (B). An 8-mm Amplatzer VSD occluder was deployed across the VSD through a 6-F, 90-cm sheath that was advanced from right basilic vein access while a pigtail catheter from the right RA was inserted in the LV for ventriculography (C). Final LV angiography showing the closed VSD (D).

Figure 5. LV angiography showing a complex, very high VSD with an aneurysmal septum (A). The VSD was crossed using a JR 4 catheter via the right RA with an angled hydrophilic wire (B). A VSD occluder was deployed from an FV approach (C). Final angiogram showing the closed VSD (D).
at equivalent cost compared with a neck approach. We preferred the AVA for this procedure, which is shown in Figure 6.

CONCLUSION

Patient-friendly, truly minimally invasive RA and AVA can be utilized for a variety of structural cardiovascular interventions, either as a primary or secondary access.

Figure 6. A 7-F, 90-cm sheath was inserted in the right atrium over a 0.035-inch J wire (A). Biopsy forceps were advanced, and ventricular septal biopsy was performed with two-dimensional echocardiography (B).

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