

Full circle and back to complete forearm access

Ian C Gilchrist

Penn State Heart and Vascular Institute, Penn State University College of Medicine, Hershey Medical Center, Hershey, PA, United States

Related article

by Saedi et al.

*Il n'y a de nouveau que ce qui est oublié
[There is nothing new except what has been forgotten]*

Mademoiselle Bertin (Milliner to Marie Antoinette)

Correspondence to:

Ian C Gilchrist, MD, FACC, MSCAI,
Professor of Medicine,
Pennsylvania State University,
College of Medicine,
500 University Drive, C1517,
Hershey, PA 17033, United States,
phone: 717 531 58 88,
e-mail:

ian.c.gilchrist.md@gmail.com

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Cardiac catheterization has evolved over the last 100 years. Werner Forssmann's 1929 placement of a ureteral catheter 65-cm up his left brachial vein into his heart [1] heralded the start of forearm venous access. Work in the 1940s by Sig Radner [2] and others [3] using the radial and ulnar arteries to explore the central arterial systems allowed the evolution of modern cardiac catheterization techniques. Access in the forearm was chosen to easily visualize and control bleeding. By the early 1950s, right heart catheterization was considered relatively safe, with a mortality rate of <0.1%, although angiography carried risk due to contrast-induced toxicities and cardiac arrest [4]. Ventricular fibrillation was the most feared complication as this was the era before there were effective defibrillation techniques.

As time progressed, access into the femoral region became feasible and relatively straightforward with percutaneous sheath techniques. Catheterization changed from an academic exploration to one of clinical medicine, and the demands of newer surgical procedures such as valve replacement and coronary bypass surgery resulted in a surge of interest in invasive cardiology. The femoral artery and its vein became the go-to access, and the concept of forearm vascular access became a fading memory.

Percutaneous radial access was revived by Lucien Campeau [5], although he envisioned this access as an adjunct technique when a femoral approach might not be feasible for diagnosis. The stent era and the need for intensified anticoagulation brought forth

bleeding as an issue. Kiemeneij and Learman [6] leveraged newer 6 F compatible equipment with the safety of the forearm approach and demonstrated that stenting was possible from a radial approach, thus reinvigorating the forearm concept. This shift in access also opened the door to outpatient, same-day stent procedures. Right heart catheterization to complement arterial catheterization from the forearm took longer to revive. Still, by the early 2000s, several diverse groups independently reported success with this approach [7, 8], and once again, complete catheterization was possible from the forearm.

Saedi et al. [9], in this issue of the Journal, have demonstrated their success with using the forearm as the venous and arterial catheterization location. They presented a series of patients with a congenital or valvular disease requiring arterial/venous catheterization and compared it against a historical control of arterial access only. Overall, the complications and success were very encouraging, although both groups appear to have relatively high rates of radial artery occlusion. This radial artery occlusion is probably not a reflection of venous access, but perhaps the long heparin times or other confounders such as concurrent anticoagulation. Beyond radial occlusion, no safety concerns were noted, and there was no need for access crossover, reflecting the ease and benefits of this approach.

While using the forearm as a substitute for standard central venous access for catheterization is a start, familiarity with this technique can expand the indications and

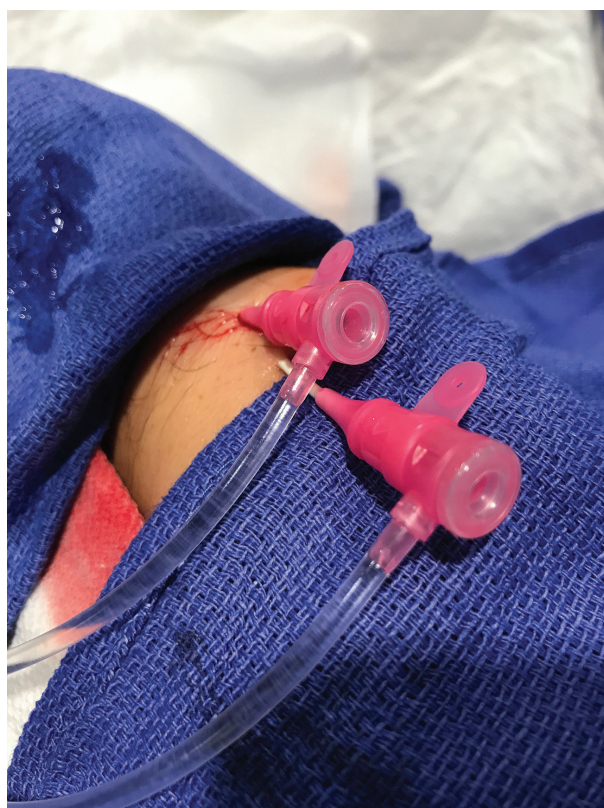


Figure 1. Access for right and left heart catheterization using 4-F introducers in the right dorsal radial artery and vein in a patient with short arms. Access obtained with ultrasound (source: Ian C Gilchrist)

streamline the care process. Since starting forearm venous catheterization at Penn State University (Hershey Medical Center, Hershey, PA, US) over 2 decades ago, we have done approximately 10 000 of these procedures with no life-threatening complications. An IV access team obtains venous access outside of the catheterization laboratory room, reducing time spent in the procedure room. Right heart catheters are available in sizes as small as 4-F with balloon tip only and 5-F with thermodilution. Both right and left heart catheterization can potentially be done *via* the dorsal radial vein and artery with 4-F equipment (Figure 1). While entry can use any vein down to the wrist, the 110-cm commercial catheters presently available are usually not long enough for many patients; the antecubital region is most commonly used. As mentioned by Saedi et al. [9], the medial vein is preferred, but even lateral veins can be successful as long as the 90-degree cephalic-axillary junction is respected. Venous catheterization is a painless procedure and certainly less of a hazard than central neck veins or femoral veins.

With forearm access, indications for right heart catheterization have expanded. We no longer stop anticoagulants before this access, and very sick patients who cannot lay down can be approached. Patients being treated for advanced heart failure can have their hemodynamics checked with a quick right heart catheterization up the

arm without subjecting the patient to the risks of more invasive approaches. This allows clinicians to confirm baseline hemodynamics and correlate them to their bedside observations. Comfort with using the arm veins has also expanded their use for right ventricular biopsy [10], intra-pulmonary artery thrombolysis, temporary pacemakers [11], placement of cava filters [12], and treatment of central venous obstructions.

Beyond the usual issues with arterial loops, anomalies, and spasms that may interfere with arterial access, the venous system can provide a variety of different challenges in part dependent on patient population. Patients with previous long-dwelling venous lines, such as dialysis catheters, can have stenosis in the veins. Pacemakers and defibrillators can also be a setup for venous obstruction. Likewise, a history of significant trauma may also foretell potential venous obstruction. The passage up the vein should be smooth, and if not, a simple venogram can often explain the problem. It may be more efficient to avoid the side with potential venous obstruction. Still, unlike the arterial system, the venous system is often redundant, and there may be many routes to the heart even if one has been obstructed.

After almost 100 years, cardiac catheterization has returned to the forearm. This should not be seen as a victory of one approach over another but rather the result of evolutionary success in technique and technology. The right location for the right procedure and the correct technique for the access site. Safe vascular access is the key. The skill-set to use a variety of sites allows the operator to consider a range of risks/benefits to the patient and pick the access best suited for the patient's wellbeing.

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