

Lifting the Veil: Insights into Vascular Access Options

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In this issue of *CJASN*, Ong *et al.* (1) and Lok *et al.* (2) address two important issues on either end of the vascular access care spectrum. Lok *et al.* (2) evaluate data pertinent to choosing the optimal access for those patients initiating hemodialysis, including the autologous native arteriovenous fistula (AVF) versus the prosthetic arteriovenous graft (AVG). At the other end of the spectrum, Ong *et al.* (1) suggest that a thigh AVG is an acceptable long-term access in patients who have lost all upper extremity options for a permanent access. Although AVF is considered the preferred access in the majority of patients, there is growing appreciation that the costs and effort of establishing such an access are considerable and that the attempt perhaps should not be made in every patient initiating or receiving hemodialysis. Undoubtedly, the increased impetus on AVF creation is to minimize use of the “least preferred access,” that is, long-term use of tunneled cuffed catheters (TCCs). This has certainly improved the rate of fistula use in the United States; however, overzealousness may have led to the unintended consequences of higher primary fistula failure rates and, in some instances, prolonged catheter use. An important question remains regarding whether achieving one functioning fistula, even at a premium, is worth it.

Thus far, the benefits of establishing an AVF have been measured in terms of long-term outcomes, patency, reduced interventions, and infections. However, the cost of obtaining this longer-term benefit should factor into the shorter-term issues of the increased number of procedures within the first 6 months to 1 year (*e.g.*, high primary failure and failure-to-mature rates), initial increased dependency on longer catheter use, and much later onset of chronic problems related to aneurysm formation, central venous stenosis, and high output states on the heart. There is little discussion of patient “fistula fatigue” due, in part, to multiple failed procedures to construct or mature the AVF (for many patients, it is cosmetically unattractive) as well as to procedures related to aneurysms and occurrence of life-threatening hemorrhagic episodes. Similarly, there are little data to compare morbidity associated with postprocedure vascular and neurologic deficits of vascular access options. Finally, failure to achieve “recommended” fistula rates places programs and dialysis centers in the “public spotlight,” with possible penalties for health care providers (3).

The report by Lok *et al.* (2) adds to increased questioning of the unwavering support of the “fistula first”

approach for all hemodialysis patients. This report highlights the limitations of the current recommendations based on historical data and prods us to reconsider the merits of the fistula first approach. Six years ago, one of us coauthored an article on the clinical epidemiology of AVFs and AVGs in which we reviewed the then-available data on the superiority of AVFs (4), which was before the publication of the National Institutes of Health–sponsored study on fistula maturation and usability (5). Similarly to this analysis, AVFs at that time lacked superiority in cumulative primary patency over grafts when primary failures were included. Due to a lack of good data, we still argued for AVFs over grafts (6). However, AVFs have a discernible advantage over grafts once the primary failure is excluded, at least in the forearm. This supremacy extends beyond patency alone because the rate of interventions, infections, and subsequent accesses needed is lower once the access matures. The role of surveillance and timely intervention is one aspect of vascular access care that is not included in the study (7,8). Although the current evidence does not robustly support prolongation of patency with surveillance, it is important to note that well designed prospective studies evaluating surveillance methods and appropriate timely intervention are lacking. The time-honored physical examination may have differential sensitivity for identifying access flow or pressure problems in AVGs compared with AVFs, accounting for the large difference in thrombolytic rates.

Either way, the question remains: Is the cost of this amenity worth it? It is likely worth it to the patient whose AVF matures promptly with few augmented procedures. In these functioning matured AVFs, from a purely economic (and humanistic) approach, Lok *et al.* (2) show that the angioplasty procedure rates to maintain patency are less than half of those in grafts and significantly fewer thrombolytic interventions are needed in AVFs than in grafts. However, it is not clear how to increase the percentage of functioning fistulae from the get-go. There is a need for better identification of patients who could benefit from a fistula. A failure-to-mature score, developed and reported by Lok *et al.* (9), is an early step in identifying patients who may have a higher probability of failure-to-mature fistula and in whom an AVG may provide as good as or better initial or subsequent access. We agree with the following key principles enunciated by Allon and Lok (10) for choosing an access: likelihood of early access

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complications and primary failure, likelihood of later access complications such as stenosis and thrombosis, catheter-related complications such as bacteremia and central vein stenosis, and expected patient survival. There is an urgent need for additional studies to identify the group of patients in whom fistula creation should not even be attempted. Research using larger databases may help to answer this question without the need for a large randomized clinical trial.

The characteristics of dialysis patients continue to change. For example, the increased number of elderly patients and increased survival on dialysis often necessitate >1 dialysis access during the patient's lifetime. High access failure rates and central venous stenosis due to intravenous devices lead to exhaustion of available upper extremity access sites. Although the optimal vascular access in the upper extremity is still being debated, atypical and creative access sites are increasing in number.

Use of the lower extremity has expanded the available vascular options even though the literature evidence is limited. Selective use of grafts in high-risk patients may afford reasonable cumulative patency with reduced exposure to the risks associated with catheters. Ong *et al.* (1) provide evidence comparing upper thigh AVGs with TCCs. To some extent, the comparison of patients initiating hemodialysis with a TCC (the reference group) versus those who require a thigh graft because they have exhausted all upper arm and central vein options may be biased because patency and survival may have differing operative pathophysiologic factors. In this study, the TCC reference group had the advantage that all TCCs were placed in the internal jugular vein location and the censoring event rate was quite high due to transition to other forms of permanent access. One should also appreciate that an AVG in the upper thigh differs from an upper extremity graft having a higher rate of infections but with similar cumulative patency (11). With these caveats, the results showed that thigh AVGs performed better in terms of patency and infection-free survival than TCCs. Preventive measures in TCCs have evolved; however, questions remain regarding whether the superiority of grafts over TCCs would be mitigated if nonheparin catheter locks (*e.g.*, citrate with antibiotics) (12) and/or weekly tissue plasminogen activator catheter locking solutions (13) were routinely used for all TCCs. Our experience at Henry Ford Hospital is that routine use of an antibiotic-citrate lock markedly reduces catheter-related blood stream infections (CRBSIs) and is associated with a marked reduction in overall mortality (14). Commercial catheter lock solution is available. Microbial resistance is a major concern for the US Centers for Disease Control and Prevention and is the primary reason for the lack of recommendations on the routine use of any prophylactic antibiotic lock although studies demonstrating efficacy in reducing CRBSIs are numerous. Finally, AVF construction is certainly feasible in the thigh (15). In the only prospective study comparing a femoral vein transposed fistula with upper thigh AVG after 1 year of follow-up, the fistula had a lower infection rate and longer patency but a higher steal rate (16).

There are other options for dialysis patients with exhausted upper extremity sites. One is the HeRO device, a composite AVG with a catheter as outflow, which has the advantage of continued use of the upper extremity. A recent

study comparing the HeRO device with a lower extremity AVG reported comparable secondary patency and infection rates at the cost of a higher number of interventions to maintain patency (17). Clinical real-world experience with this device, however, has been quite variable and some would not recommend it at all. The option of peritoneal dialysis is too often forgotten in these patients. Very little evidence exists on the use of peritoneal dialysis in patients with end stage vascular access, longer dialysis vintage, and likely loss of residual renal function. More robust prospective studies are needed to evaluate the outcome of these various options in patients with exhausted upper extremity access sites.

Ongoing debate on optimal hemodialysis access in both early and late dialysis vintage highlights the complex nature of vascular access care and will continue to evolve. Optimal dialysis access should be individualized and patient centered, with a common goal of "catheter last."

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The authors have no disclosures related to the content of this manuscript. See the Supplemental Material for the authors' full disclosures.

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