



Vascular Access, Mortality, and Home Hemodialysis: Back to the Future

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Establishing permanent vascular access in patients treated with hemodialysis is a fundamental management challenge for the clinical nephrologist. While clinical practice guidelines are unified in the recommendation for the arteriovenous fistula as the first-choice vascular access for hemodialysis,¹⁻⁴ the majority of patients throughout the western world commence hemodialysis therapy with a catheter. Although not the only reason for recommending the arteriovenous fistula as first choice, the link between vascular access type and mortality is an important consideration in the approach to individual patients.

Defining the relationship between vascular access type and mortality has been the subject of numerous epidemiologic studies over the past 15 years.⁵ Early studies^{6,7} were rightly criticized due to the lack of comprehensive adjustment for confounding factors associated with catheter use such as late referral (to name just one). Subsequent studies assessed a broad range of dialysis populations using advanced statistical techniques to address the “treatment by indication bias” whereby patients with catheters are older and have a higher comorbid condition burden.^{8,9} A recent systematic review¹⁰ of the literature summarized these data, demonstrating that dialysis using a catheter was associated with higher risks for all-cause, cardiovascular, and infectious mortality (53%, 38%, and 102% greater, respectively) compared to dialysis using an arteriovenous fistula. However, concerns about selection bias will remain given the nonrandomized nature of the studies included in the review.

In the previous work addressing the vascular access–mortality relationship, a particularly important group of patients was either excluded or contributed very few patients to the studies: patients treated with home hemodialysis (HHD). The lack of data for this population is particularly pertinent for 2 reasons. First, patients treated with HHD are different from their “conventional” hemodialysis counterparts. They are younger, have fewer comorbid conditions, and are often highly motivated in managing their health and

kidney disease treatments. Given these factors, these individuals are precisely the group of patients less likely to dialyze using a catheter. Thus, any study addressing the vascular access–mortality question in a specific HHD population will likely have a cohort of younger patients with fewer comorbid conditions using catheters to compare with those using permanent vascular access. It is therefore possible that this may aid in reducing the amount of confounding observed in previous studies. Second, patients using HHD are treated with a wide range of varying dialysis regimens ranging from short daily dialysis (seen predominantly in the United States)¹¹ to long (6–8 hours) alternate day or daily nocturnal dialysis (seen in Canada, Australia, and New Zealand).^{12,13} The common theme to HHD prescriptions is the increased frequency of dialysis treatment sessions, which may be associated with an increase in vascular access complications. This of course could work both ways. The increased frequency of arteriovenous fistula/graft venipuncture is likely to increase the risk for complications such as infection and/or bleeding, and recent data¹⁴ suggest that this might be the case. Equally likely, increased dialysis frequency in patients with catheters also could increase the risk for infection due to the increased frequency of catheter manipulation necessary for connecting the dialysis lines. It is not unreasonable to hypothesize that the vascular access–mortality relationship may be very different in this patient group compared with patients treated with conventional hemodialysis.

On this background, a study by Perl et al¹⁵ in this issue of *AJKD* represents an important addition to the literature and debate in the relationship between vascular access and mortality/morbidity. In an analysis of data from the Canadian Organ Replacement Register (CORR), Perl et al assessed both patient and technique survival of 1,869 patients treated with HHD over a 16-year period from 1996 to 2012. In a number of ways, analysis of CORR data represents the best and perhaps the only opportunity to explore the question of vascular access and mortality in the HHD population. HHD, in particular nocturnal hemodialysis, has been an important feature of dialysis practice in Canada for many years.¹² In addition, unlike many other countries in which HHD is commonly practiced (eg, Australia and New Zealand¹³), physicians in Canada have not seen catheter use as a barrier to HHD. Therefore, the Perl et al study presents the opportunity to examine a large group of patients using HHD with catheters and compare them with patients with permanent vascular access.

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Perl et al¹⁵ present a number of important findings. First, in agreement with all previous studies addressing the vascular access–mortality relationship, individuals undergoing HHD with permanent vascular access had a significantly lower risk for death compared with those using a catheter. The lower risk for death remained robust to sensitivity analyses, including assessment of only those who had vascular access information within 90 days of commencing HHD therapy. These results are particularly important given that the baseline differences between patients using a catheter compared with those using permanent vascular access were not marked: there were no significant differences in age, hypertension, coronary artery disease, diabetes, or body mass index between the groups. A greater proportion of women than men were using catheters (44% vs 27%) and peripheral vascular disease was more common in patients who used a catheter rather than a permanent vascular access, although the overall rates of disease were low (8.4% vs 5.0%, respectively). Second, when the combined end point of survival and technique failure was assessed, those using permanent vascular access remained at a significantly lower risk for death or technique failure compared with those with catheters. Finally, when the risk for technique failure was assessed alone, results were the same, with similar point estimates but a loss of significance, likely due to the lower statistical power. Although patient survival is an important outcome, technique survival is equally important and may be more important to patients.¹⁶

A couple of important limitations of the current study need highlighting. Despite the mentioned similarities between patients dialyzing with catheters and those using permanent vascular access, both observed and unobserved differences remain, and therefore the possibility of residual confounding remains. However, recent data addressing the issue of residual confounding in the assessment of HHD compared to conventional hemodialysis with both catheters and arteriovenous fistulae suggest that the amount of residual confounding needed to completely nullify the observed effects is larger than what would be clinically plausible.¹⁷ Missing data for vascular access type was also a particular problem in the study, and although the investigators explored numerous methods to help overcome this problem, it remains an important limitation.

How might these findings be used in clinical practice? First and foremost, catheter use, especially at the commencement of hemodialysis therapy, remains unjustifiably high. The available data demonstrate that catheter use affects patient survival and is an important cause of morbidity and costs.¹⁰ The nephrology community needs to continue to work toward a catheter-last, permanent vascular access–first policy.¹⁸ Drivers for the different rates of catheter use across countries

remain largely unexplored but are likely driven by nephrology practice patterns rather than initial patient preference. However, there remains a clear need to target patient populations for which clinical equipoise exists regarding the benefits of an arteriovenous fistula compared to a catheter. One such population could be elderly hemodialysis patients.^{19,20} A randomized study comparing catheter use versus either an arteriovenous fistula or arteriovenous graft could be justified on the basis of clinical equipoise.^{18,21,22}

For the HHD patient, the findings of Perl et al¹⁵ suggest that every effort should be made to establish permanent vascular access to reduce the risk for not only death but also technique failure. However, we also know that vascular access is an important barrier to the uptake of HHD as a treatment option.²³ Both patients and caregivers alike highlight vascular access as a major concern or barrier to dialyzing independently, with the fear of self-cannulation cited as the major impediment.^{24,25} Comparisons of HHD rates in different countries suggest that vascular access should not be a barrier. For example, in Australia and New Zealand, where rates of HHD remain high (~11% and 18%, respectively), prevalent catheter rates are low, with just 8% to 10% of patients dialyzing with a catheter.¹³ This compares to Canada, where the catheter rate in HHD patients is 30%, with an overall rate of prevalent HHD at 4% in 2012.^{15,26} Tailoring dialysis modality education as well as HHD training to address patient-based barriers should be a priority.

The study by Perl et al¹⁵ represents the power of dialysis registries to advance knowledge and decision making in specific groups of dialysis patients, a feat that single-center-based studies cannot achieve. As a nephrology community, we should be grateful to the patients who consent for their data to be collected and used for such studies, as well as the physicians, nurses, and other personnel who maintain and manage such registries.

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