Vascular Access for Hemodialysis and Value-Based Purchasing for ESRD

Rajnish Mehrotra,* Alfred K. Cheung,†‡ Timothy Meyer,§ and Karl A. Nath†

*Kidney Research Institute and Harborview Medical Center, Division of Nephrology, Department of Medicine, University of Washington, Seattle, Washington; †Division of Nephrology and Hypertension, Department of Internal Medicine, University of Utah, Salt Lake City, Utah; ‡Division of Nephrology and Hypertension, Department of Medicine, Veterans Affairs, Salt Lake City Healthcare System, Salt Lake City, Utah; §Division of Nephrology, Department of Medicine, Stanford University, Palo Alto, California; and †Division of Nephrology and Hypertension, Department of Medicine, Mayo Clinic, Rochester, Minnesota


Successful treatment of ESRD with maintenance hemodialysis is inextricably dependent on a reliable access to the bloodstream several times every week. Indeed, although the principles of extracorporeal treatment had been developed earlier, it was only with the introduction of the arteriovenous shunt by Belding Scribner and Wayne Quinton that made long-term treatment of uremia with hemodialysis feasible.1 With improved understanding and innovations over the ensuing five decades, there are now primarily three choices for vascular access—arteriovenous fistula (AVF), arteriovenous graft, and central venous catheter. However, each vascular access type imposes unique risks to the health of patients and further increases health care utilization. Hence, determining the access type associated with the lowest health risk and health care utilization is of great interest to patients, physicians, and health care providers, as well as payers of health services.

Although no randomized, controlled trials have been completed to date, a large number of cohort studies have examined the differences in health outcomes among patients with different types of vascular access. In a meta-analysis of 62 cohort studies with 586,337 participants, compared with patients with an AVF, those with central venous catheters had higher risks for
all-cause mortality, fatal infections, and cardiovascular events (risk ratio [RR], 1.53; 95% confidence interval [95% CI], 1.41 to 1.67; RR, 2.12; 95% CI, 1.79 to 2.52; and RR, 1.38; 95% CI, 1.24 to 1.54, respectively). Furthermore, patients with arteriovenous grafts had significantly higher risks for all-cause mortality and fatal infections compared with those with AVFs (RR, 1.18; 95% CI, 1.09 to 1.27; and RR 1.36, 95% CI, 1.17 to 2.52, respectively). Studies also indicate that patients with central venous catheters have significantly higher risks for nonfatal infections, including metastatic infections (such as endocarditis, septic arthritis, and osteomyelitis), and noninfectious complications, such as central venous stenosis and venous thromboembolism. The higher risk for death and hospitalizations in patients with central venous catheters compared with arteriovenous access extends to those undergoing home hemodialysis. Patients with functioning arteriovenous grafts also have a higher incidence of access thrombosis and shorter event–free patency than patients with AVFs. On the basis of this large body of evidence from observational studies, the AVF is widely regarded as the preferred vascular access type. As with observational studies, confounding and other biases may not be adequately controlled for, and causality cannot be established.

Using the evidence base from cohort studies and supported by clinical practice guidelines, the Centers for Medicare and Medicaid Services (CMS), the payer of dialysis services for the vast majority of patients in the United States, has been actively promoting the use of AVFs as the preferred vascular access type, with the twin goals of improving health outcomes and lowering costs. In 2004, the Fistula First Initiative was introduced as a quality improvement initiative administered through the 18 End Stage Renal Disease Networks around the country. Since that time, the proportion of patients with functioning AVFs has almost doubled from 32% in 2003 to 63% in 2013. The vascular access type has now also become a part of the CMS’s value–based purchasing program, the Quality Incentive Program, as a criterion for determining whether a dialysis facility will be subjected to withholding in payments starting in 2014. As structured, the quality measure incentivizes the placement of AVFs and disincentivizes the use of central venous catheters for 90 days or longer. Finally, the vascular access types comprise two of the nine quality measures in the CMS’s Five Star Rating system for dialysis facilities since 2014.

The preference for an AVF ingrained both in clinical practice and public policy presupposes that health risks and higher costs with an arteriovenous graft or central venous catheter are causal and would decrease if the patient had an AVF instead. Moreover, the purported benefits of an AVF accrue only for a functioning AVF; and public policy does not consider that up to 50% or more of AVFs may never adequately mature, resulting in higher health care utilization and catheter dependence compared with if an arteriovenous graft was placed instead. Additionally, creating AVFs is not without complications: specific upper arm fistulas may require general anesthesia when placed, and sometimes, they may need additional interventional procedures (ligating venous branches or angioplasty for stenosis) to achieve maturation.

Two studies published in this issue of the Journal of the American Society of Nephrology make important contributions to this debate. In the first study, Quinn et al. undertook a retrospective cohort study of 2300 patients who initiated hemodialysis in five Canadian programs and showed that patients <65 years of age who merely had attempts made at AVF placement before start of maintenance dialysis, regardless of the success or failure of the AVF to mature, had significantly lower risk for death than those in whom no such attempts were made. In patients ≥65 years of age, the risk changed over time, such that individuals with attempts at creation of AVF predialysis had a lower risk for death in the first 24 months but a higher risk thereafter. Importantly, <5% of all deaths were directly related to the access type, questioning the premise for a causal link between access type and death. In the second study, Brown et al. analyzed the data of patients ≥67 years of age initiating hemodialysis between 2005 and 2008 from the US Renal Data System linked to Medicare claims. Similar to the study by Quinn et al., the study by Brown et al. showed that the patients who had an AVF placement attempted before initiation of dialysis had a lower risk for death compared with those who did not, regardless of whether the AVF was functional. Compared with patients who had no attempt at AVF placement before initiating dialysis, the death risk was lower in those with a predialysis attempt at AVF placement, even when they started dialysis using a central venous catheter, although the risk was higher than in those who started dialysis with a functioning AVF. This further raises the possibility that the association of a higher risk for death in patients with central venous catheter may represent, at least in part, residual confounding from potentially poorer predialysis care or coexisting illnesses and/or confounding by indication. That is, the higher risk for death seen in patients starting dialysis with a central venous catheter may be the result of poorer predialysis medical care or caused by conditions that preclude successful placement of arteriovenous access rather than the risk from a central venous catheter itself. It follows then that the health and cost dividends of maximizing the placement of AVF may not be as large as they may seem from cohort studies published to date.

Conversely, these studies do not show the equivalency of health outcomes in patients with different access types. In the cohort studied by Quinn et al., two thirds of the patients who did not undergo attempts at creation of an AVF before start of dialysis never had such an attempt thereafter and continued treatment with a central venous catheter instead. In the study by Brown et al., patients who started with a central venous catheter, despite having had attempts at AVF creation before start of dialysis, indeed had a higher risk for death compared with those who had a functional fistula at initiation of dialysis. Finally, Quinn et al. only considered the direct causes of death from the vascular access but did not consider their potential downstream or subtle effects. For example, it has been posited—although with limited supporting evidence—that some of the higher risk for death with central venous catheters and
arteriovenous grafts may be caused by their ability to induce low-grade chronic systemic inflammation among other effects. Finally, none of these studies examined other relevant outcomes, such as hospitalizations, nonfatal infections, noninfectious complications, patient-reported outcomes, or health care costs.

In conclusion, the preponderance of evidence indicates that AVF is the vascular access type associated with the lowest health risk, health care utilization, and costs. However, the evidence is derived exclusively from cohort studies, and as illustrated by the studies by Quinn et al.9 and Brown et al.,10 a significant proportion of risk attributed to central venous catheters may represent unmeasured confounding and confounding by indication. Consequently, the health benefits and cost savings from the current clinical practice and public policy may not be as large as anticipated, particularly in elderly patients who have a shorter life expectancy. This uncertainty makes a compelling case for a randomized, controlled trial in a subgroup of patients, such as those who are old and frail and have multiple comorbidities, comparing health outcomes and costs with AVFs, arteriovenous grafts, and central venous catheters. In the meantime, it would be prudent for regulatory agencies and payers of health services to allow more room for clinical judgment to better match vascular access type to patients’ health conditions and preferences and focus instead on preventing infections without regard to vascular access type, such as is already done in the United States through reporting events to the National Health Safety Network.

DISCLOSURES
None.

REFERENCES


Changing Paradigms in Contrast Nephropathy

Arnaldo Lopez-Ruiz,* Kiran Chandrashekar,† and Luis A. Juncos‡

*Division of Critical Care, Department of Medicine, Mayo Clinic, Rochester, Minnesota; and †Division of Nephrology, Department of Medicine and ‡Department of Physiology and Biophysics, University of Mississippi Medical Center, Jackson, Mississippi


The advent of radiologic imaging revolutionized our diagnostic capabilities by allowing us to noninvasively view internal body structures. Its resolution was further augmented by the development of radiographic contrast media. Consequently, contrast-enhanced radiologic imaging has become indispensable in disease diagnosis, making intravascular contrast one of the most common medical substances used. Each year, over 8 million L intravascular contrast media are used in over 80 million procedures worldwide.1 Because of their extensive usage, the presence of any adverse reactions, either anaphylactoid or nonanaphylactoid, could result in wide-ranging consequences. Fortunately, most types of adverse reactions are either relatively mild or infrequent, except for renal dysfunction. Contrast nephropathy is described as an increase in serum creatinine beginning 1–3 days after an intravascular contrast dose that is not attributable to any other cause. It was not described until the early 1950s, decades after the introduction of intravascular