Individualization of Vascular Access Care: Dream or Reality?

By Prabir Roy-Chaudhury MD, PhD

Scope of the problem

Hemodialysis vascular access is without question the lifeline for the more than 400,000 patients undergoing hemodialysis in the United States. Unfortunately, because of the high incidence of dialysis vascular access dysfunction, it is also the “Achilles heel” of hemodialysis (1, 2). There are currently three main forms of permanent dialysis vascular access, each of which have their pros and cons.

Arteriovenous fistulae (AVFs) are the preferred form of permanent dialysis vascular access because of their prolonged long-term survival and lack of infection. Indeed, the Fistula First initiative has increased the current AVF prevalence from under 30 percent to over 60 percent in the United States. The main complication of AVFs is a very high failure-to-mature rate (defined as the inability of the AVF to increase blood flow and diameter adequately to support hemodialysis). Currently, as many as 60 percent of AVFs are unsuitable for dialysis between 4 and 5 months after surgery (3). Some of these failures could be due to the placement of AVFs in patients with small vessels or with other predictors of AVF failure. The main reason for AVF maturation failure at a pathogenetic level is likely a combination of an aggressive neointimal hyperplasia (myofibroblastic and smooth muscle cell ingrowth from the media) combined with a possible lack of outward remodeling (dilatation) (1, 4).

Arteriovenous grafts (AVGs), by contrast, do not have these early failure-to-mature problems, and over 90 percent of surgically created AVGs can in fact be used for hemodialysis within the first 6 weeks after surgery. The main problem with AVGs, unfortunately, is a predictable stenosis at the graft–vein anastomosis resulting from neointimal hyperplasia, which is responsible for a dismal 1year primary patency of only 23 percent. The least desirable form of permanent dialysis vascular access is the tunneled dialysis catheter (TDC), which carries a huge morbidity and mortality burden as a result of catheter-related bloodstream infections, fibrin sheath formation, which results in inadequate blood flow, and central vein stenosis. Despite the significant increase in both morbidity and mortality and the cost associated with TDC dysfunction (5), almost 80 percent of new (incident) patients starting hemodialysis do so with a TDC.

Current vascular access care paradigms

An important focus of the broader vascular access community—physicians, nurses, hospitals, and payers (particularly the Centers for Medicare and Medicaid Services)—over the past decade has been on the Fistula First initiative. This initiative, which began over 10 years ago, has been amazingly successful in that it has increased the AVF prevalence rate from under 30 percent to over 60 percent currently (6). Whereas the Fistula First initiative was clearly the need of the day when the AVF prevalence rate was low, it is unclear whether the same drivers are still in play, with the current AVF prevalence rate of 61 percent nationally. In particular, the higher AVF prevalence suggests that targeting high-risk patients with technology and process of care interventions could be effective in increasing AVF prevalence.

First, it is likely that as we develop novel therapies for dialysis vascular access dysfunction that can reduce neointimal hyperplasia, enhance outward remodeling, or reduce postangioplasty restenosis, these therapies could be preferentially used in patients at high risk for dialysis vascular access failure. Second, such an enhanced “predictor panel” could also be used to individualize the initial choice of vascular access, in that patients at high risk of AVF maturation failure could receive an AVG instead. Such a choice could potentially also reduce the current epidemic of TDC use during prolonged periods of AVF maturation. Last but not least, patients at higher risk of dialysis vascular access dysfunction could be placed into a more intensive “process of care” pathway in that they could be fast tracked for early surgery and more aggressive follow-up with dedicated vascular access coordinators.

Putting it all together

We strongly believe that we need to move away from a one-size-fits-all paradigm into a construct wherein we try to individualize vascular access care in such a manner that we place the right access in the right person at the right time (Figure 1). To do this, however, we desperately need high-quality and well-validated predictors, particularly those that are derived from the biologic aspects of vascular access dysfunction.

Individualizing dialysis vascular access care could significantly reduce the morbidity and mortality burden (redundant endovascular/surgical interventions and prolonged TDC use with all its attendant complications) associated with dialysis vascular access dysfunction, and as a result improve the quality of life of our hemodialysis patients. In addition, as we move into an era of bundled dialysis payments, individualization of dialysis vascular access care could also result in significant savings in health care costs: smart medicine by any other name.

References


Figure 1. Individualization of dialysis vascular access care

The availability of high-quality clinical and biologic predictors could help to individualize every aspect of vascular access care from the selection of the right vascular access type in a particular patient to the application of targeted process of care and novel therapies to treat dialysis vascular access dysfunction in selected patients.

Abbreviations: AVF = arteriovenous fistula; AVG = arteriovenous graft; DAVD = dialysis vascular access dysfunction; POC = process of care; NT = new therapies; TDC = tunneled dialysis catheter.

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Updates in Dialysis