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# Improving Patient Safety in Vascular Access: A Role for Individualization and Patient Preferences

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**Abstract**

Patient safety is central to the practice of medicine. Traditional pathways to improve patient safety have included better education of patients and better training of health care professionals. In this chapter, we make the case for a nontraditional approach to patient safety in the setting of dialysis vascular access which focuses on (a) the development of a patient-centric process of care, (b) individualization of care (personalized medicine), and (c) the use of novel and safer therapies. 

**Recommendations to Improve Patient Safety**

- Provide opportunities for the patient to participate in their own care through pathways for self-cannulation and voicing of patient preferences (what is important to the patient).
- Develop pathways for individualization of care (personalized medicine).
- Focus on the process of care with well-defined roles and responsibilities for all team members.
- Advocate for the use of new technologies that reduce complications.

## Introduction

Dialysis vascular access is currently the 'lifeline' for hemodialysis patients. Unfortunately, due to the many complications associated with dialysis vascular access, it is also the 'Achilles heel' of hemodialysis. A relatively ignored aspect of dialysis vascular access pertains to patient safety. The first part of this chapter will describe patient safety issues in the traditional context of arteriovenous fistulas (AVFs), arteriovenous grafts (AVGs) and tunneled central venous catheter (tCVC). In the second half of this chapter, however, we will make the case that a nontraditional approach which emphasizes (a) individualization of care, and (b) patient preferences and patient involvement may be our best opportunity to improve patient safety in hemodialysis patients.

## Traditional Patient Safety Issues in Dialysis Vascular Access

### *Arteriovenous Fistulas*

AVFs remain the preferred form of dialysis vascular access due to their superior long-term patency and lack of infection. The main disadvantage of AVFs is a very high incidence of maturation failure (defined as the inability to use the AVF for dialysis due to inadequate flow and diameter), likely due to a combination of neointimal hyperplasia and inadequate outward remodeling in the perianastomotic region [1, 2]. This stenotic lesion can at times also result in thrombosis. A long period of AVF maturation, however, often results in prolonged dependence on tCVCs with all their attendant risks of infection, thrombosis and central vein stenosis. The prolonged presence of a tCVC could also push health care professionals towards more aggressive cannulation regimens. While this is not a bad idea, early cannulation could potentially result in large infiltrations, which would necessitate resting the AVF and so prolong even further the duration of tCVC dependence and the risk of infection [3, 4]. An additional issue that has recently come to light in the context of cannulation is an increased risk of infection with the buttonhole technique, although there is likely to be a well-selected and defined patient population that could benefit from this approach, especially with the right infrastructure, training and process of care [5–8].



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### *Arteriovenous Grafts*

In marked contrast to AVFs, AVGs do not have a problem with early maturation failure, with the vast majority being cannulated between 3–6 weeks after surgery. Unfortunately, they do have significant problems with stenosis (most commonly at the graft-vein anastomosis) and thrombosis, with a recorded one year unassisted primary patency as low as 23% [9]. In addition, polytetrafluroethylene (PTFE) grafts have an infection rate of approximately 10% over the lifetime of the graft.

### *Tunneled Central Venous Catheters*

Although tCVCs allow for the immediate initiation of patients onto hemodialysis, they can result in very significant complications as a result of catheter-related bloodstream infections, thrombosis, inadequate dialysis and central venous stenosis. Recent data also document a very significant increase in mortality, especially within the first 90 days of hemodialysis in patients initiating dialysis with a tunneled dialysis catheter as compared to those starting dialysis with an AVF or AVG [10]. Despite these statistics, almost 80% of patients starting dialysis in the US do so with a tCVC, with only a quarter of these patients having a maturing AVF. Thus, 60% of all patients starting dialysis in the US do so with no real plan for permanent dialysis vascular access. We believe that this epidemic of incident tCVC use is perhaps the biggest safety risk associated with dialysis vascular access at the current time. How can we best address this problem?

### *Is There a Solution?*

The best solution would of course be for every patient to start hemodialysis with an AVF that was ready to use. This would require significant focus on the process of care in the chronic kidney disease (CKD) stage, including early referral to nephrology and to the access surgeon, aggressive programs for vein preservation and venous mapping, the services of a dedicated vascular access surgeon, identification and early intervention in the setting of AVF nonmaturation and the use of master cannulators for the initial cannulations. More than anything else, we believe that spending resources on vascular access coordinators would result in the greatest potential impact on successful AVF placement and maturation during the CKD phase. In our minds, this would likely have a huge positive impact on patient safety in the context of dialysis vascular access.



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## Individualization of Care

While trying to ensure that every patient has a functional AVF at the time of starting hemodialysis is a laudable goal, it is important to do this in the context of individualization of vascular access care. Thus, while an AVF would be the vascular access of choice in young to middle-age patients with adequate vessel size and estimated glomerular filtration rates around 25–30 ml/min, this may not hold true for a middle-aged patient with extensive comorbidities and small vessels who is already dialyzing through a tCVC. In this latter instance, placement of a PTFE graft (perhaps even an early cannulation graft) may be a more appropriate plan of action from the patient safety aspect since this would result in earlier removal of the tCVC.

Similarly, recent data suggest that patient survival is similar for octogenarians who initiate dialysis with either a PTFE graft or an AVF, with catheters doing far worse. This is particularly important information in the context of the large numbers of unnecessary procedures that are often performed in elderly patients who have AVFs placed during the CKD stage, in that these patients often die prior to the initiation of hemodialysis [11]. Based on the papers by DeSilva et al. [12, 13], PTFE grafts placed within a month of the initiation of hemodialysis might be the preferred option both at the clinical and the patient safety level in older patients with CKD.

Another approach that could optimize patient safety related to vascular access in the future could be the use of novel therapies to enhance vascular access survival. Thus, the best vascular access care plan for the middle-aged man with multiple comorbidities, small vessels and a tCVC already in place as described above may in the future not just be a PTFE graft, but rather an AVF in combination with a wrap or other device to improve AVF maturation and subsequent rapid tCVC removal.

## Patient Involvement and Patient Preferences

Finally, we strongly believe that the best way to reduce patient safety issues related to dialysis vascular access is to actively involve patients in the whole process of vascular access care. This could be at the level of patient involvement or patient preferences.



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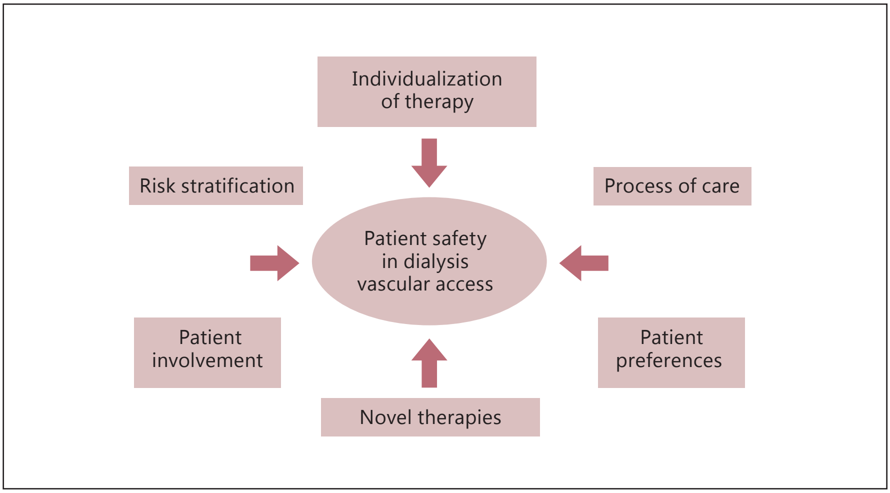


**Fig. 1.** A nontraditional approach to patient safety in dialysis access.

## *Patient Involvement*

Active patient involvement and education about the pros and cons of the different types of dialysis vascular access including the concept of individualization of vascular access care as described above could go a long way towards the enhancement of patient safety in vascular access. Another important aspect of patient involvement could be the use of self-cannulation. This could potentially not only reduce the incidence of infiltrations, but also give 'ownership' of the vascular access to the patient.

## *Patient Preferences*

Linked to the concept of patient involvement is the adoption of patient preferences. We believe that an individual patient's perception of the risks and benefits of the different forms of dialysis vascular access may be quite different from those of the health care professionals. An older patient with multiple comorbidities and limited survival may feel that the use of a tCVC which avoids needle sticks may be preferable to an AVF which may need multiple procedures to be able to support dialysis. Although the concept of bringing patient preferences into the decision making mix for dialysis vascular access is new, we believe that it could allow us to develop a much more holistic and patient-centric approach to dialysis vascular access safety.



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## Conclusions

Patient safety in dialysis vascular access cannot be considered to be a stand-alone field in its own individual silo.

We have therefore described a nontraditional, albeit more holistic approach to patient safety for dialysis vascular access (fig. 1), which emphasizes process of care pathways, individualization of therapy through risk stratification and the use of novel technologies, active patient involvement and identification of individual patient preferences.

We strongly believe that adoption of such a *patient-centered* approach to dialysis vascular access could have a very positive impact on patient safety in dialysis vascular access.

## Disclosure Statement

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