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How is Arteriovenous Fistula Longevity Best Prolonged?:

The Role of Surveillance

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While arteriovenous fistulas (AVF), the preferred type of access for end stage renal disease (ESRD) patients on hemodialysis, have significantly better outcomes (and lower associated costs) than arteriovenous grafts (AVG) or tunneled hemodialysis catheters (TDC)¹, access dysfunction still contributes substantially to ESRD patients' morbidity and mortality. While vascular access stenosis caused by neointimal hyperplasia (NIH)² is the most common cause of access dysfunction, thrombosis is by far the most feared complication. It requires an urgent thrombectomy procedure to reestablish the lifeline of dialysis patients and, if not successful, urgent TDC placement. Similarly, vascular stenosis is the most common cause of access thrombosis³. Therefore vascular access stenosis is the culprit for dysfunction and thrombosis; however the important question remains whether early detection of vascular stenosis reduces access thrombosis and prolongs access life.

Vascular access monitoring is defined as performing physical examination of the vascular access by a qualified individual on regular basis⁴. Access monitoring is a simple and quick evaluation that can help to diagnose vascular stenosis and other access abnormalities⁵. Several studies have clearly shown its value in detecting vascular stenosis. Hemodialysis access examination should be taught to all clinical care providers (dialysis technicians, dialysis nurses, vascular access coordinators, nephrology fellows and nephrologists). Such a training and education should be adopted by every nephrology training program.

Hemodialysis access surveillance on the other hand is defined as the use of additional tools and instrumentation to perform regular periodic evaluation for early detection of vascular access stenosis⁴. There are numerous instrumentations and tools that use access flow, access pressure or duplex ultrasound to perform this task. Several observational studies and some randomized controlled trials (RCT) have been reported which evaluate the value of all types of surveillance on access life and access thrombosis rate.

There is an abundance of observational studies in the literature evaluating all types of access surveillance methods (intra access flow and pressure measurements, ultrasound duplex)^{6–10}. Though these studies are not easily comparable, they lead to a conclusion that regular surveillance programs can significantly decrease access thrombosis and may prolong access life. In contrast, the RCTs show conflicting results on the benefit of surveillance in reducing

access thrombosis. These results led many to doubt the value of surveillance and advocate its futility.

Notably, The National Kidney Foundation Kidney Disease Outcomes Quality Initiative (KDOQI) categorizes surveillance with intra access flow as preferred for both AVFs and AVGs and surveillance with intra access pressure as preferred for AVGs and only acceptable for AVFs⁴. Even when narrowing the search for RCTs with focus on surveillance using intra access flow measurement we see that results are still conflicting. Along with the focus of this review on AVF, there are only four RCTs that involved AVFs (Table-1)¹¹⁻¹⁴.

Tessitore et al. included a total of 36 patients in the control group and 43 patients in the treatment group¹⁴. Their results were positive as they showed that surveillance with intra access flow decreased access thrombosis and prolonged AVF life. Polkinghorne et al. similarly included 137 patients with AVF in their RCT and resulted in a non-significant doubling in the detection of AVF stenosis¹¹. They reported four thromboses in the control group and six in the surveillance group but acknowledged that the study was underpowered to evaluate thrombosis as an outcome.

Scaffaro et al randomized 108 patients with 111 AVFs in their trial to two groups¹³. Control group received standard care with clinical and hemodynamic assessments and the interventional group which underwent clinical monitoring and surveillance with Duplex ultrasound every three months. Primary outcome was access thrombosis and need for tunneled hemodialysis catheters. The interventional group had significantly less need for tunneled hemodialysis catheters (25.9% for control group and 7.5% for interventional group; $p=.021$). Even though there was no significant difference in access thrombosis between the two groups (24.1% vs. 17% for control and interventional groups respectively; $p=0.487$), there was a significant difference between the composite end points of thrombosis or tunneled dialysis catheter need (44.8% vs. 20.8%; $p=0.033$).

Sands et al. randomized 68 patients with AVF (and 35 patients with AVG) in their trial to three groups¹² - (1) access flow with color flow Doppler by ultrasound every 6 months, (2) static venous pressure surveillance and (3) color flow Doppler ultrasound every 6 months with no monthly monitoring. They found that surveillance with intra access flow measurement access reduced thrombosis rate.

All these RCTs have significant limitations. Many of them had small sample size of patients enrolled that affected the power of the study and therefore the validity of the results. Similarly questions were raised in regards to the RCTs design including primary and secondary outcomes. In preliminary results (not published yet) of a metanalysis conducted at the University of Miami of all surveillance RCTs (AVFs and AVGs) showed clear trend of surveillance using intra access flow measurement to reduce access thrombosis.

Access monitoring is of paramount value. It should be part of the training for all dialysis care providers including all nephrology training programs. Establishing such an educational training is relatively inexpensive and at the same time can have great rewards to the care of our dialysis patients. We emphasize the KDOQI recommendation to perform access monitoring monthly. We suggest that it should even be considered for every encounter with

the patient. KDOQI also recommends having a surveillance program in place for hemodialysis units. However such a program will face financial challenges as such a measurement is not reimbursed by Medicare and therefore other insurance companies. This is probably due to the lack of a well-designed study to support its use and due to the conflicting results of the existing studies. Therefore we are in desperate need for a well-designed RCT adequately powered to evaluate the value and benefits of surveillance. Such RCT should have access thrombosis as a solid primary outcome and the need for tunneled hemodialysis catheters as a secondary outcome. Such a study will provide the long awaited answers.

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References

1. USRDS. 2010 USRDS Annual Data report. 2010. http://www.usrds.org/2010/view/v2_11.asp#top
2. Manning E, Skartsis N, Orta AM, Velazquez OC, Liu ZJ, Asif A, Salman LH, Vazquez-Padron RI. A new arteriovenous fistula model to study the development of neointimal hyperplasia. *Journal of vascular research*. 2012; 49:123–131. [PubMed: 22249138]
3. Turmel-Rodrigues L, Pengloan J, Rodrigue H, Brillet G, Lataste A, Pierre D, Jourdan JL, Blanchard D. Treatment of failed native arteriovenous fistulae for hemodialysis by interventional radiology. *Kidney international*. 2000; 57:1124–1140. [PubMed: 10720965]
4. KDOQI) TNKF KDQIN. 2006. http://www.kidney.org/professionals/KDOQI/guideline_upHD_PD_VA/indexhtm
5. Asif A, Leon C, Orozco-Vargas LC, Krishnamurthy G, Choi KL, Mercado C, Merrill D, Thomas I, Salman L, Artikov S, Bourgoignie JJ. Accuracy of physical examination in the detection of arteriovenous fistula stenosis. *Clinical journal of the American Society of Nephrology: CJASN*. 2007; 2:1191–1194. [PubMed: 17928468]
6. Besarab A, Sullivan KL, Ross RP, Moritz MJ. Utility of intra-access pressure monitoring in detecting and correcting venous outlet stenoses prior to thrombosis. *Kidney international*. 1995; 47:1364–1373. [PubMed: 7637266]
7. Cayco AV, Abu-Alfa AK, Mahnensmith RL, Perazella MA. Reduction in arteriovenous graft impairment: results of a vascular access surveillance protocol. *American journal of kidney diseases*. 1998; 32:302–308. [PubMed: 9708617]
8. McCarley P, Wingard RL, Shyr Y, Pettus W, Hakim RM, Ikizler TA. Vascular access blood flow monitoring reduces access morbidity and costs. *Kidney international*. 2001; 60:1164–1172. [PubMed: 11532113]
9. Safa AA, Valji K, Roberts AC, Ziegler TW, Hye RJ, Oglevie SB. Detection and treatment of dysfunctional hemodialysis access grafts: effect of a surveillance program on graft patency and the incidence of thrombosis. *Radiology*. 1996; 199:653–657. [PubMed: 8637982]
10. Schwab SJ, Raymond JR, Saeed M, Newman GE, Dennis PA, Bollinger RR. Prevention of hemodialysis fistula thrombosis. Early detection of venous stenoses. *Kidney international*. 1989; 36:707–711. [PubMed: 2530385]
11. Polkinghorne KR, Lau KK, Saunderson A, Atkins RC, Kerr PG. Does monthly native arteriovenous fistula blood-flow surveillance detect significant stenosis--a randomized controlled trial. *Nephrology, dialysis, transplantation*. 2006; 21:2498–2506.
12. Sands JJ, Jabyac PA, Miranda CL, Kapsick BJ. Intervention based on monthly monitoring decreases hemodialysis access thrombosis. *ASAIO journal*. 1999; 45:147–150. [PubMed: 10360713]

13. Scaffaro LA, Bettio JA, Cavazzola SA, Campos BT, Burmeister JE, Pereira RM, Barcellos CS, Caramori P. Maintenance of hemodialysis arteriovenous fistulas by an interventional strategy: clinical and duplex ultrasonographic surveillance followed by transluminal angioplasty. *Journal of ultrasound in medicine*. 2009; 28:1159–1165. [PubMed: 19710213]
14. Tessitore N, Lipari G, Poli A, Bedogna V, Baggio E, Loschiavo C, Mansueto G, Lupo A. Can blood flow surveillance and pre-emptive repair of subclinical stenosis prolong the useful life of arteriovenous fistulae? A randomized controlled study. *Nephrology, dialysis, transplantation*. 2004; 19:2325–2333.

Table 1

List of randomized controlled trials that included AVFs.

Study	Total patients	Number of patients with AVF	Number of patients with A VG	Primary end point	Results
Sands ¹²	103	68	35	Thrombosis	Positive
Polkinghorne ¹¹	137	137	0	Stenosis	Negative
Tessitore ¹⁴	79	79	0	Thrombosis	Positive
Scaffaro ¹³	111	111	0	Thrombosis & TDC need	Positive