

Vascular access for dialysis – the Portuguese experience

Carlos Oliveira

Nephrology Department, Hospital Garcia de Orta, Almada
Coordinator of the Study Group on Vascular Accesses for Hemodialysis

Vascular access quality for chronic hemodialysis is a determinant factor in the success of this treatment. Since the advent of dialysis in 1940 and later with the success of chronic dialysis treatment, vascular access has become an important issue. The Quinton and Scribner Shunt¹ became available in 1960 and the arteriovenous Brescia-Cimino-Appel fistula was first described in *The New England Journal of Medicine* a few years later².

The construction of new vascular accesses (VA), how to improve maturation and prevent failure, to fix stenosis' VA dysfunction, to prolong patency, to prevent and treat thrombosis are all challenges and research areas. Vascular access and its complications are important causes of morbidity; traditionally a major cause of hospitalization and have significant costs all over the world. These costs represented 500 million dollars/year in the USA in the nineties³ and in 2013 fee-for-service Medicare paid \$2.8 billion for dialysis vascular access related services, representing 12% of all end-stage renal disease payments⁴.

Despite its importance, VA was not a subject of basic and clinical investigation in the first 20 years of dialysis and only since 1992 has it been considered an important research field, becoming part of the scientific program of the annual meeting of American Society of Nephrology.

Aware of this new attention to VA problems, and aiming to do more than observe the repeated sequences of events leading to access failures, we feel it's time to invest in new procedures. Reports of interventional angiography that treat problems related with VA dysfunction, angioplasty of peripheral and central stenosis and recovery of thrombosed grafts looked very promising and rewarding. Pedro Ponce, gifted with a visionary and scientific perspective, went to Austin, Texas to observe in loco interventional angiography. We later had the opportunity to also work in Austin with Gerald Beathard and learn about interventional angiography (IA) procedures, their possibilities, advantages, limitations and caveats. It was after implemented in Hospital Garcia de Orta in 1997. We decided from the beginning not to perform diagnostic angiography unless there was a special indication from a surgeon, and to use angiography just for intervention, angioplasty or stenting. To help in this task, Pedro Ponce edited the 1997 manual "Acesso à diálise, a perspectiva nefrológica", with the help of the hospital's medical and nursing team. Gerald Beathard was one of the book's co-authors, from where we take the following citation: "Faced with rising costs and national health service difficulties, it becomes apparent that the nephrologist must develop future strategies for caring for hemodialysis patients in a more economical way fashion".

Since the '90's there has been monitoring and surveillance of vascular access and new technology has become available. Physical examination (PE) was the main approach, complemented by what were considered more objective methods. These included recirculation (R), dialysis dose, standardized dynamic venous pressure of Steve Schwab (DVP)⁵, standardized static venous pressure of Anatole Besarab (VPO)⁶, intra-access blood flow (Qa) with different dilution techniques based on Krivitsky's theory (ultrasonic, conductivity, hematocrit, temperature, sodium, and so on). Ultrasonography (US) is a powerful surveillance tool because it allows the physician to directly measure the access flow and to hemodynamically evaluate the stenosis. Nevertheless, US is considered by many authors as very operator dependent. Most of these methods are more suitable for grafts than fistulas, while others can be used in native fistulas as well as grafts.

The targets of monitoring and surveillance were to detect stenosis and prevent thrombosis. Although these targets were very effective in identifying stenosis, their capacity to predict thrombosis was low. This was more significant in grafts, where more thrombosis episodes occur.

PE remains the most relevant tool and must be the primary diagnostic VA evaluation and a basis for all other methods and interventions. US equipment has increased in quality with better image resolution, improvements in software and data, better criteria (resistive index, flow, systolic peak velocity (SPV), SPV ratios, diameters, and so on), but these parameters need to be better validated. US can be used for vascular mapping for preoperative planning of dialysis access, including a systematic evaluation of arterial and venous examination. It allows the study of the VA and helps nursing staff to choose the best cannulation sites, and areas to avoid puncture. Additionally, it can be used to guide angioplasty⁸ and may be used as an alternative to angiography in some instances. The use of US for every patient or in selected patients remains to be determined.

Interventional angiography (IA) has changed a lot since its beginning. We treated initially more grafts than fistulas, more procedures related to thrombosis. Now we have less grafts than in the past, with a similar decrease of procedures in grafts. Fistula maintenance is an increasing cause of angiographic interventions, namely to fix stenosis, improve maturation and prevent failure. This trend is similar to other international centers and published data. Other indications for IA are central stenosis and central catheter dysfunction. The number of procedures did not decrease with the increase in fistula utilization for prevalent patients. A significantly progressive improvement in procedure outcomes and a decrease in complication rates and procedure times were also observed⁷.

The first vascular access guidelines were published in 1997 by the National Kidney Foundation-Kidney Disease Outcome Quality Initiative (NKF-KDOQI): “NKF-K/DOQI Clinical Practice Guidelines for Vascular Access.” Dialysis access management changed significantly after that. More guidelines have been presented but so far many of them have a low level of evidence. Some authors state that a low level of evidence can be useless or even deleterious for some patients. More data and quality studies on VA are needed.

The treatment of VA has changed greatly in Portugal too. The introduction of vascular access management in the comprehensive payment of dialysis treatment has resulted in the implementation of vascular access centers (VAC), with surgery and / or interventional angiography available. This has resulted in better patient access to these procedures and a good improvement of VA management and treatment. Nevertheless, the first VA of an incident patient remains the sole responsibility of the hospital where the patient is followed by a nephrologist. We can observe a huge difference in access to first VA and in timely performed first VA across patients from different regions and different reference hospitals. The sharing or splitting of payment and responsibility from the first VA and its maintenance, and the subsequent VA, is a potential source of problems and discrepancies. These must be evaluated, prevented and corrected. More than 50% of incident patients in Portugal initiate dialysis treatment with a catheter and only less than 40% with a fistula. This trend has worsened over recent years. This was evidenced by the registry of the Sociedade Portuguesa de Nefrologia, the “Portuguese Registry of Dialysis and Transplantation 2018”, and was an issue presented and discussed at the last meeting “Reunião do Núcleo de Acessos Vasculares 2019”.

Surgery plays an important role in the development of non-maturation VA and improving outcomes. Motivated teams and innovated surgical approaches are needed to maximize fistula creation with lower primary failure rates, as well as to prevent and treat complications, including new alternative accesses to complex patients.

A VA team is a multidisciplinary one in which nephrologists, surgeons and nurses work together. Nurses play a primary role within the team because they evaluate and puncture the access at least 3 times per week.

We should do more to promote VA research, specially multicenter trials, involving several teams. We should also improve patient information on the care of VA and the procedures that are needed to maintain its well-functioning.

Nephrologists must remain involved in VA management, because we are the only professionals with the knowledge of the patient, the access, and the dialysis procedure. PE should be the basis for VA care, followed by US when necessary. VA teams should develop their algorithms to determine the best treatment to maintain VA. This expertise minimizes unnecessary procedures on the one hand and too-late approaches on the other. Investment in IA expertise also increases efficiency and minimizes complications. This reflects Portugal's successful experience in the VA care of hemodialysis patients.

Disclosure of potential conflicts of interest: none declared.

References

1. Quinton W, Dillard D, Scribner BH. Cannulation of blood vessels for prolonged hemodialysis. *Trans Am Soc Artif Intern Org.* 1960 Apr 10-11;6:104-13.
2. Brescia M, Cimino J, Appel K. Chronic Hemodialysis Using Venipuncture and a Surgically Created Arteriovenous Fistula. *N Engl J Med* 1966;275:1089-92.
3. Feldman H, Held P, Hutchinson J et al. Hemodialysis Vascular Access morbidity in the United states. *Kidney Int.* 1993;43:1091-5.
4. Thamer M, Lee T, Wasse H et al. Medicare Costs Associated With Arteriovenous Fistulas Among US Hemodialysis Patients. *AJKD* 2018; Vol 72:10-8.
5. Schwab S, Raymond J, Saeed M, Newman G, Denis P, Bollinger R. Prevention of hemodialysis fistula thrombosis. Early detection of venous stenosis. *Kid Int* 1989;36:707-11.
6. Besarab A, Sullivan K, Ross R, Moritz M. Utility of intra-access pressure monitoring in detecting and correcting venous outlet stenoses prior to thrombosis. *Kidney Int* 1995;47(5):1364-73.
7. Beathard G, Urbanes, Litchfield T. Changes in the Profile of Endovascular Procedures Performed in Freestanding Dialysis Access Centers over 15 Years. *Clin J Am Soc Nephrol* 2017;12:779-86.
8. Marques M, Maia p, Barreto C, Carvalho T, Ponce P. Ultrasound-guided angioplasty, a suitable alternative in some patients Angioplastia guiada por eco-doppler, uma alternativa adequada para alguns doentes. *Port J Nephrol Hypert* 2015;29(2):146-53.

Correspondence to:

Carlos Oliveira, MD
Nephrology Department, Hospital Garcia de Orta, Almada