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Management of end-stage vascular access failure patients: a retrospective analysis

Joana Gameiro, José Agapito Fonseca, Sofia Jorge, José António Lopes

Division of Nephrology and Renal Transplantation, Department of Medicine, Centro Hospitalar Lisboa Norte, EPE

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ABSTRACT

Vascular access (VA) dysfunction is an important cause of morbidity and mortality in the hemodialysis (HD) population. Regardless of the increasing prevalence of HD patients with complex VA, the definitions of VA failure (VAF) or end-stage VA failure (ES-VAF) are still being discussed and there is no current guideline that provides recommendation for solving the problem of complicated vascular access. The aim of this study was to review the management approach for resuming the continuity of RRT in patients with problematic vascular accesses, based on our center experience.

In a retrospective analysis of 30 patients with VAF or ES-VAF over an 11-year period, twenty patients were transferred to peritoneal dialysis (PD), seven patients remained in HD after the placement of a non-standard site VA and three patients had a renal transplant (RT). In half of these patients, the initial therapeutic option eventually failed, leading to multiple reinterventions and RRT changes. Mean survival was 47 ± 32.7 months. Ten patients died, the majority within the first year of VAF diagnosis.

The management of end-stage renal disease patients includes vessel preservation, the combination of RRTs to extend life expectancy and VA care to maintain long-term function. Our approach stratifies patients according to exhausted VA sites in order to plan for RT, transition to PD or alternative VA site management. This allows for better management of the VAF patient and highlights the need to individualize patient care.

Keywords: Vascular access, hemodialysis, peritoneal dialysis, renal transplant, approach

INTRODUCTION

Hemodialysis (HD) remains the most common starting renal replacement therapy (RRT) and is the main modality in most cases of prolonged RRT.[1,2] A functional vascular access (VA) is required to perform a successful and effective HD session.[3] The prevalent VA used is associated with numerous patient characteristics, such as age, sex, and ethnicity.[4] VA dysfunction is an important cause of morbidity and mortality in the HD population.[3] In fact, up to 30% of hospitalizations in HD patients are related to VA complications, and VA-associated costs constitute approximately a quarter of total end-stage renal disease medical spending.[5]

In addition, the type of VA used at the beginning and for long-term maintenance dialysis reflects on morbidity and mortality. The arteriovenous fistula (AVF) is the optimal VA for HD which is associated with superior long-term outcomes and lower infection and intervention rates.[6,7] Strategies have been implemented to increase the frequency of AVFs in HD patients.[6-8] Arteriovenous grafts (AVGs) might have comparable outcomes to AVFs in the short term, despite increased intervention rates, and central venous catheters (CVC) have lower patency and higher infection and complication rates.[9-11] Furthermore, there is a higher risk of infectious complications and mortality in patients initiating HD with a catheter compared with either a fistula or graft.[4,9-11] Nevertheless, patient-related factors also account for some of this difference in outcomes.[9-11]

The progress in nephrological care has improved the survival of HD patients; however longer duration of HD will require multiple VAs in several patients, as only a minority of patients sustain AVFs in the long-term.[12] Recurrent access failure culminates in the exhaustion of standard options of VA and prompts the need to develop strategies to prevent but also to manage this condition.[13,14]

Regardless of the increasing number of HD patients with complex VA, the definitions of VA failure (VAF) or end-stage VA failure (ES-VAF) are still being discussed. Al Shakarchi et al developed an anatomically based classification reflecting the degree of severity of access failure, and defined end-stage access failure as a bilateral venous occlusion or severe stenosis which renders standard upper limb access options non-viable.[12]

The management of end-stage renal disease patients includes vessel preservation, the combination of RRTs (HD, peritoneal dialysis (PD) and renal transplant (RT)) to extend life expectancy and VA care to maintain its long-term function.[13-15]

A literature review shows there is no current guideline that provides recommendations for solving the problem of complicated vascular access. The aim of this study was to review the management approach for resuming the continuity of RRT in patients with problematic vascular accesses based on our center experience.

METHODS

We performed a retrospective analysis of 30 patients who were admitted to our department with VAF/ES-VAF between January 2006 and December 2016.

VAF was defined as recurrent loss of a permanent VA for HD, namely recurrent AVF or AVG thrombosis and/or recurrent CVC dysfunction, requiring intervention.

ES-VAF was defined as the inability of catheter insertion into any of the central veins due to stenosis or thrombosis documented by computed tomography angiogram or angiography.

Statistical significance was defined at $P < 0.05$. Analyses were performed with the statistical software package SPSS 21.0 for Windows.

RESULTS

During this eleven-year period, 30 patients with serious VA problems were admitted to our hospital. Sixteen had ES-VAF (53.3%). Sixteen were females (53.3%) and ten were blacks (33.3%). The mean age at the beginning of renal replacement therapy (RRT) was 56.4±17.2 years. Nine patients were older than 65 years (30%). In all 30 patients, initial RRT was HD with mean treatment period 5±4.1 years. Clinical characteristics of the study population are shown in Table 1.

Table 1

Patient characteristics

Characteristic	Value
ES-VAF – n (%)	16 (53.3)
Gender (female) – n (%)	16 (53.3)
Race (blacks) – n (%)	10 (33.3%)
Cause of renal disease – n (%)	
Unknown	8 (26.6)
Hypertensive nephrosclerosis	7 (23.3)
Chronic interstitial nephritis	7 (23.3)
Autosomal dominant polycystic disease	4 (13.3)
Chronic glomerulonephritis	3 (10)
Diabetic nephropathy	1 (3.33)
Thrombophilia- n (%)	3 (10)
Age at RRT beginning (years) – mean ± SD	56.4 ± 17.2
Patients older than 65 years at RRT beginning – n (%)	9 (30)
Duration of RRT (years) – mean ± SD	5 ± 4.1
Survival after diagnosis of VAF (months) – mean ± SD	47 ± 32.7
Follow-up (months) – median	72
Mortality – n (%)	10 (33.3)

Black patients were younger (44.3±10.2 vs 64.4±17.8, p=0.003) and had less time in HD (3.2±1.4 vs 6±3.4, p=0.023). These patients came from African countries to Portugal to solve their VA complications. These patients had no previous AVF or AVG and had multiple catheters inserted, which culminated in central stenosis in all cases.

The cause of renal disease was unknown in 8 patients (26.6%); in the remaining patients, hypertension was the cause in 7 (23.3%); 7 had chronic interstitial nephritis (23.3%); 4 had autosomal dominant polycystic disease (13.3%); 3 chronic glomerulonephritis (10%) two of whom had lupus nephritis, and one patient had diabetic nephropathy (3.33%).

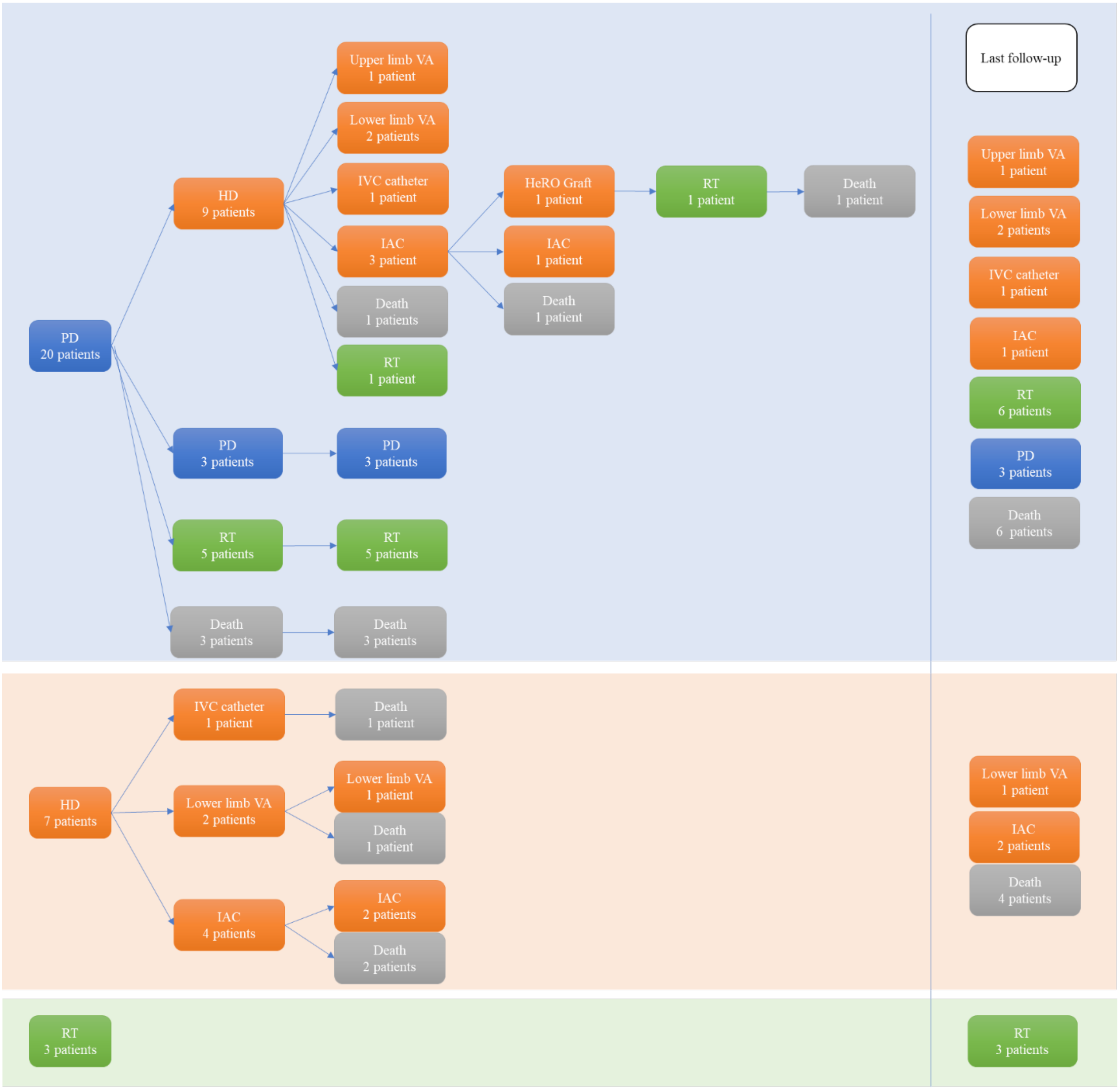
Eleven patients (36.7%) were studied for thrombophilia, and only 3 patients were positive (one for Leiden factor V mutation, one for lupic anticoagulant, and one for anti-beta-2-glycoprotein).

All patients with VAF diagnosis had multiple prior surgical or endovascular interventions on their VA, ultimately culminating in VA loss. The incidence of patients with prior primary VA failure was 16.7% (n=5). Twenty-two patients had central vein stenosis (73.3%).

Concerning RRT option at VAF diagnosis, twenty patients (66.7%) were transferred to PD, seven patients (23.3%) remained in HD after the placement of a non-standard site VA, namely, four with a CVC in the right atrium, two with a lower limb VA, one graft and one tunnelled catheter, one with a CVC in the inferior vena cava, and three patients (10%) were submitted to an RT. In half of these patients, the initial therapeutic option eventually failed, leading to multiple reinterventions and RRT changes. (Figure 1)

Figure 1

Evolution of RRT options in our cohort of VAF patients



At the last follow-up, nine patients (30%) had an RT, eight patients (26.7%) were in HD with an alternative VA (three lower limb grafts, three CVCs in the right atrium, one CVC in the inferior vena cava, one upper limb graft placed after angioplasty), and only three patients (10%) remained in PD. (Table 2)

Table 2

Renal replacement therapy at different follow-up times

	Beginning of RRT	After VAF diagnosis	Last follow up
HD – n (%)	30 (100)	7 (23.3)	8 (26.7)
PD – n (%)		20 (66.7)	3 (10)
RT – n (%)		3 (10)	9 (30)

Mean survival, starting on diagnosis of VAF, was 47 ± 32.7 months. Median follow-up was 72 months. Mean survival of patients who remained in HD with non-standard site VA was 13.3±9.1 months, whereas mean survival of patients who were transferred to PD or received a kidney transplant was 60±28.4 months.

In the subgroup of black patients, PD was possible in 80% of cases (80% vs 65%, p=1.0) and RT was possible in 40% of cases (40% vs 30%, p=0.584). There was a tendency to lower mortality in these patients (1% vs 45%, p=0.055).

No patients older than 65 years were submitted to an RT; also, mortality was higher in older patients (66.7% vs 19%, p=0.011).

Ten patients died, and in 60%, death was in the first year after VAF diagnosis. Six patients were in HD, three on PD and one had an RT. Cause of death was sepsis in 50% of patients (n=5), acute myocardial infarction in 40% of patients (n=4) and pulmonary embolism in 10% of patients (n=1).

DISCUSSION

With the increasing rate of HD patients and the increased survival in this technique, there is an increasing number of patients who have exhausted definitive vascular access options, particularly black patients with multiple comorbidities and peripheral vascular disease, and patients with thrombophilia, predisposed to recurrent VA thrombosis.[16]

In our cohort, 30 patients presented with VAF, with an incidence of 2.7 patients per year, resulting in multiple hospital admissions and re-interventions.

One third of our patients with VAF/ES-VAF were black, many of whom were relocated from Africa to Portugal due to complex VA complications. Also, these patients did not have PD or RT available in their country. This subgroup of patients was younger, spent less time on HD and had fewer cardiovascular comorbidities. Although not attaining statistical significance, mortality was lower in this subgroup, possibly due to their younger age.

In patients older than 65, due to the severity of cardiovascular and malignancy comorbidities and/or and short life expectancy, RT was not an option.

Although this is a particular cohort of patients due to the aforementioned aspects and a relatively small number of patients, it points us towards important conclusions regarding the importance of ethnicity in the earlier presentation of VAF, as suggested in the literature.[17]

ES-VAF does not occur progressively nor present similarly in all patients; however, the development of an algorithm to guide the management of these complex and challenging situations may be helpful in improving outcomes.

Our population had a mean RRT duration of 5±4.1 years, which highlights the importance of careful VA and RRT planning in order to prolong technique and patient survival, as the mortality rate is high in the presence of ES-VAF, and it was the rotation through different RRT that allowed survival of most patients.

When maintenance in HD presents a difficult task to achieve, PD provides an extension of RRT.[18] Previous studies suggested a short-term survival advantage of PD over HD as the initial RRT, although patient characteristics tended to be different, for instance, PD patients were usually younger, with fewer co-morbidities, higher hemoglobin concentrations, superior nutritional status, and more residual renal function. In contemporary cohorts, survival of patients performing HD or PD is similar.[19-21]

The impact of PD in prolonging overall patient survival is considerable. In all our VAF/ES-VAF patients, HD was the initial RRT, which highlights the importance of RRT planning and the important role that PD-first might play in prolonging survival by preserving blood vessels.

For suitable candidates, preemptive RT provides the best outcomes among available modalities of RRT.[22] The impact of RT is even greater in the survival of eligible patients for whom dialysis is no longer an option. Therefore, a timely preparation, the preservation of vascular territory for RT by avoidance of lower limb VA placement, and the prioritization of VAF/ES-VAF patients in the transplant lists are essential in the management of these patients.

Al Shakarchi et al's classification provides an important tool in classifying patients with VAF that may still be candidates for an RT and who should perhaps be on a priority list.[15] According to this classification, 70% of patients in our cohort (n=21) were class III (without VA option in upper and lower limbs). Of these, three patients were transferred to PD, thirteen patients remained in HD with alternative VA sites and five patients were submitted to an RT. Also, 80% of the patients (n=8) who died were class III patients who remained in HD. This classification demonstrates the importance of recognizing different groups of VAF severity and appropriately planning alternative RRT options.

Our country provides a high-urgency (HU) transplant list for VAF/ES-VAF patients in whom PD is not an option, which is what allowed the nine patients to have an RT. Notably, RT was performed with vascular anastomosis to IVC in five patients, reflecting the exhausted blood vessels for RT. At the last follow-up, all but one patient submitted to RT were alive with a functioning graft.

When conventional VA sites are not available or when patients are not PD or RT candidates or who are awaiting the latter, the placement of venous catheters in alternative locations has allowed for the prolonged survival of these patients and maintenance in HD.[23]

Lower limb VA appear to be a significant marker for mortality in HD patients, as this type of VA is associated with multiple complications and is only placed when no other sites are available.[24]

The Hemodialysis Reliable Outflow (HeRO) graft provides a definitive vascular access solution, creating an alternative option for VAF patients.[25-28]

Lower limb grafts and HeRO have similar outcomes and poor patency; nevertheless, they have lower infection and intervention rates than tunneled catheters, suggesting they can be considered as alternative VA after conventional upper limb VA options have been exhausted and before considering catheter-dependence.[28]

Despite being associated with significant risks and high mortality, intra-atrial catheter (IAC) placement has emerged as a life-saving procedure for ES-VAF patients.[30-32]

In our population of VAF/ES-VAF patients, seven were submitted to an IAC placement, with need for multiple reinterventions. Only three patients still remain in HD with an IAC; four patients have died.[30] Important to note that one patient, after multiple episodes of catheter dysfunction, was submitted to a HeRO placement and shortly after received an RT. This patient died shortly after the RT with a pulmonary embolism.

The main complications associated with IAC are catheter dislodgement with cuff exposure, catheter thrombosis and infections, although the infection rates are lower than with other catheter locations.[32]

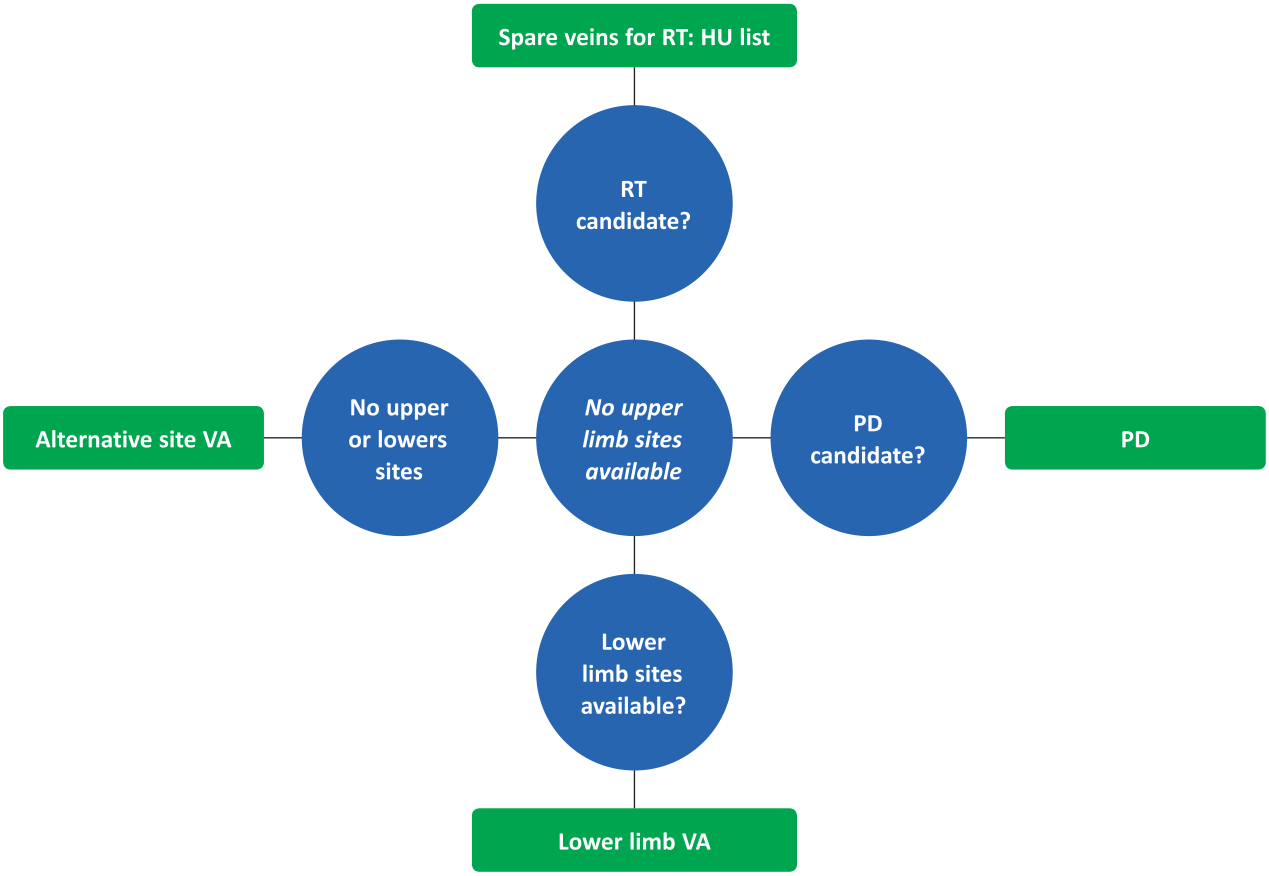
Other potential, however uncommon, alternative locations for catheter placement include hepatic[33,34], lumbar[35,36], renal (37-39), neck collaterals[40], cephalic[41], hemiazygous, and azygous veins.[42,43]. These sites should only be used as a last resort when all the common sites are exhausted.

Over the years, our experience seems to point towards the following approach proposed in Figure 2. For patients with no upper limb VA sites, one must first take into account that if the patient is a candidate for RT, iliac veins and inferior vena cava should be spared. Transition to PD should be considered, sparing lower limb or considering alternative VA sites if PD is unavailable or after technique failure. For patients with no upper or lower limb VA sites, transition to PD and/or alternative VA sites should be considered. If eligible for RT and if other RRT alternatives are impossible, the patient should be proposed for emergent RT. The same careful approach to spare veins for RT should be taken into consideration. Transition to PD and alternative VA sites should be considered while on the waiting list. For patients with no alternative VA sites for HD, transition to PD is the only option while on the waiting list for an RT. When VA are exhausted, individual consideration should be taken for emergent RT. If PD is impossible, as well as HD or RT, conservative therapy can be considered.

This approach has enabled better management of VAF patients and we believe it can be useful in solving

Figure 2

VAF management approach



RT – renal transplant; PD – peritoneal dialysis; HU – high urgency

this complex condition. Also, we highlight the need to individualize patient care and to consider an integrative model of RRT, with the different modalities as interdependent in order to extend the life expectancy and quality of life of patients.[44] This requires careful planning with appropriate and timely referral to specialists, with a crucial articulation between different medical and surgical specialities to devise strategies of prevention and management of VAF and, thus, should occur along the continuum from pre-dialysis care to the time when the access subsequently fails and ultimately exhausts all available options.

Disclosure of potential conflicts of interest: None declared.

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Correspondence to:
Joana Gameiro, MD
Division of Nephrology and Renal Transplantation,
Department of Medicine
Centro Hospitalar Lisboa Norte, EPE
Av. Prof. Egas Moniz, 1649-035 Lisboa, Portugal
joana.estrelagameiro@gmail.com