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Monitoring program of native accesses for hemodialysis

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SUMMARY

Vascular access failure is an important cause of morbidity and mortality for patients on haemodialysis. We have prospectively studied, with a 5 years follow up, a monitoring protocol of native vascular accesses, using the available methods in every haemodialysis unit.

All the native vascular accesses, created from I-1998 to XII-2001, with a posterior follow up until XII-2002, were monitored. Monitoring was based on physical examination, dificulty for blood flow greater than 300 ml/min, and in a monthly basis: dynamic venous pressure, urea recirculation and urea kinetic model. Abnormalities suggestive of fistulogram were a priori *defined.*

During the recruitment period, a total of 164 accesses were created in 144 patients. Of these only 3 were grafts, 28 native vascular accesses were never functioning (primary failure rate 17.1%), and 127 native accesses created in 113 patients (age 63.3 ± 12.4 years; 18% diabetics), were monitored (83% cephalic vein).

Monitoring findings indicated realization of fistulogram in 35% and percutaneus angioplasty in 25% of the accesses. In order to maintain patency, the surgical intervention rate was 0.03 procedures/patient/year, the radiological 0.10 and the total 0.13. During the 5 years of the study occurred 41 thrombosis episodes in 40 accesses (0.07 thrombosis/patient/year), with percutaneus repermeabilization in 30%. Primary (unassisted) survival was 30.3 months (Confidence Interval 95% 25.6, 35.0) and secondary (assisted) survival 42.8 months (Confidence Interval 95%: 38.7, 46.9).

Logistic regression analysis showed that presence of a central catheter at the time of creating the vascular access posses a greater risk for thrombosis (Relative Risk 5.6 if in subclavian vein), whereas age, diabetes, time to canulation, number of previous accesses and anatomic type do not increase that risk.

In conclusion, in an old haemodialysis population, with an important diabetes prevalence, it is possible to create functioning native vascular accesses in most of them. The monitoring protocol allowed the detection and posterior correction of stenosis in a great number of accesses. The main risk of thrombosis is the presence of a central catheter at the time of creating a vascular access.

Key words: ***Vascular acces, catheter, thrombosis, haemodyalisis.***

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PROGRAMA DE MONITORIZACIÓN DE ACCESOS VASCULARES NATIVOS PARA HEMODIÁLISIS

RESUMEN

El fallo del acceso vascular es causa importante de morbimortalidad en los pacientes en hemodiálisis. Se presentan los resultados de un estudio prospectivo, durante 5 años, aplicando un protocolo de monitorización de los accesos vasculares nativos.

Se monitorizaron, utilizando métodos disponibles en cualquier Unidad de Diálisis, todos los accesos nativos realizados desde I-1998 hasta XII-2001, con un seguimiento posterior hasta XII-2002. La monitorización se basó en examen físico, dificultad para flujo mayor de 300 ml/min, y mensualmente, de modo alterno: presión venosa dinámica, recirculación de urea y su modelo cinético. Se definieron a priori *las alteraciones indicativas de realización de fistulografía.*

Durante el período de reclutamiento se realizaron 164 accesos a 144 pacientes. De estos accesos sólo 3 fueron prótesis y 28 accesos nativos nunca funcionaron (fallo primario 17,1%). Se monitorizaron 127 accesos nativos (83% vena cefálica) realizados a 113 pacientes (edad 63,3 ± 12,4 años; 18% diabéticos).

Indicadas por anomalías en la monitorización se realizaron fistulografías en el 35% de los accesos y angioplastia de estenosis en el 25%. Las tasas de intervención quirúrgica para mantener la viabilidad fueron de 0,03 procedimientos/paciente/año, la radiológica de 0,10 y la total de 0,13. En los 5 años se produjeron 41 episodios de trombosis en 40 accesos (0,07 trombosis/paciente/año), con repermeabilización percutánea en el 30%. El tiempo de supervivencia primaria fue de 30,3 meses (Intervalo de Confianza al 95%: 25,6, 35,0) y el de la acumulativa 42,8 meses (Intervalo de Confianza al 95%: 38,7, 46,9).

El análisis de regresión logística demostró que la presencia de un catéter central al crear el acceso confiere un riesgo mayor de trombosis (Riesgo Relativo 5,6 si en subclavia), mientras que la edad, diabetes, tiempo de utilización, número de accesos vasculares previos y tipo del mismo no lo incrementan.

En conclusión, el protocolo de monitorización permitió detectar y corregir estenosis en numerosos accesos vasculares nativos. En un porcentaje elevado de trombosis se produjo la recanalización percutánea del acceso. El mayor riesgo de trombosis detectado fue la presencia previa de un catéter en vena subclavia.

Palabras clave: ***Acceso vascular, catéter, fístula arteriovenosa, trombosis, hemodiálisis.***

INTRODUCTION

Vascular access failure is an important morbidity cause among hemodialysis (HD) patients, with a high hospital admission rate for its complications[1-4]. DOQI (Dialysis Outcome Quality Initiative) guidelines were published in 1997[5] with aiming at favoring autologous arterial-venous fistulae (avf) in relation to prostheses and reducing thrombosis and infection rates. To achieve this goal, these guidelines recommend that centers implement monitoring programs in order to detect vascular accesses with failure risk and use methods that extend their lifetime[2, 5-12]. Health providing systems aim at achieving a more effective health care with regards to well-being and users' satisfaction. Quality control represents a tool for improving health provision quality, considering the latter as the measure by which health services improve the probability of favorable health outcomes. Health services quality assessment allows the introduction of correcting measures and adjustments of detected deviations. According to these principles, DOQI guidelines propose the implementation of quality assurance programs for vascular accesses and suggest, as clinical indicators, the percentage of autologous avf used as a first vascular access, accesses complications rates, their underlying causes, and their survival[13].

Monitoring comprehends examination and assessment of the vascular access in order to detect phy-

sical signs that may suggest the presence of pathology. In cases of vascular prostheses for HD, it has been demonstrated that monitoring to detect hemodynamically significant stenoses, together with their repair, improves their lifetime and decrease the incidence of thrombosis[5-8]. Although used methods for detecting prosthesis stenosis do not seem to be as effective in autologous avf, the current opinion, although with scant studies, is that they should be equally monitored[6, 14].

Considering the high morbidity associated to vascular access failure, and that quality of life and prognosis of HD patients may be improved by increasing the number and survival of native vascular accesses performed, the goals for this study were:

- To develop and implement a monitoring protocol for stenosis detection of «native» vascular accesses, by using the available methods at the Department hemodialysis units.
- To set up the basis for a future quality assurance program using the following indicators: the percentage of native avf as a first vascular access, the primary failure rate, primary and cumulative survival, and thrombosis rates and their causes.

MATERIALS AND METHOD

Patients

All patients with chronic renal failure on HD program in whom a native vascular access was performed between January 1998 and December 2001, with a further follow-up until December 2002.

Monitoring

It includes the following components:

1. «Registration form» of the vascular access: demographic data, presence or absence of diabetes, number of previous accesses, and cause of their failure are recorded.
2. «Monitoring form» which comprises[13]:

– Access physical examination: in each dialysis session, before puncture of the access, we evaluate the degree of edema, collateral circulation and aneurisms. On a monthly basis: severity of vascular murmur by means of auscultation at the anastomosis level, intermediate and distal tract of the avf, with + (mild), ++ (easily audible), and +++ (very intense). This physical examination was done and registered by the dialysis nurse staff, informing the nephrologist in charge of the Unit about possible changes and/or observed abnormalities that he/she checks up.

– Dynamic venous pressure: on a monthly basis. Normal values for each access were established with measurements done during the first dialysis session. Venous pressure was measured during the first 5 minutes of the session, recording the monitor readings: the first one at a blood flow of 200 mL/min and, thereafter, another reading at 300 mL/min. This pressure was standardized for monitor, dialyzer, lines and needles, recording if changes in usual monitor device, dialysis procedure, lines, membrane, or dialyzer surface area occurred. In order to consider a change as significant, venous pressure had to exceed the basal value in three consecutive sessions.

– Difficulty achieving the usual blood flow: on each HD session. Its value is recorded in all dialysis diagrams, which are reviewed by the nephrologist in charge of the Unit. Values lower than 300 mL/min in two consecutive sessions were considered as significant, after having excluded other causes of possible stenosis (needles position, channeling difficulties, arterial hypotension, etc.).

– Urea recirculation: bimonthly. Calculated with the «two needles and low flow» method, within 30 minutes of dialysis session. Every recirculation higher than 10% was repeated on the following session to confirm it and the results were compared with the efficacy parameters.

– Dialysis effectiveness: bimonthly, in months not concurrent with calculation of recirculation, by using the urea monocompartment kinetic model (Daurguidas second generation). Every obtained kt/v lower than expected for a particular patient was repeated on the following session to confirm it.

Fistulography was indicated to confirm one or more changes recorded in the monitoring form: decrease of vascular murmur intensity; increase of venous pressure; difficulty obtaining blood flows greater than 300 mL/min; urea recirculation greater than 10% and/or kt/v decrease greater than 10%. Not only acute changes were recorded but also their time course. Diagnostic fistulographies were performed with a Philips Integris 2000 digital substraction angiography device. Radial-cephalic avf were approached through an artery and humeral avf through a vein. In the latter case, a blood pressure cuff, positioned several cm above the puncture site, was inflated up to 220 mmHg to study arterial-venous anastomosis.

In patients with hemodynamically significant stenoses (> 50%) an angioplasty was performed as a second procedure, except in those situations where it was considered technically impossible. A high-

pressure balloon was used, inflated up to 15-20 atm depending on the stenosis resistance. It was always approached through an anterograde venous route, except in lesions located less than 3-4 cm from the anastomosis in which a retrograde puncture was performed.

DEFINITIONS AND INDICATORS[15]

Primary outcome: thrombosis-free vascular access survival.

Secondary outcomes:

– Primary failure: an access that has never been appropriate for dialysis.
– Primary failure rate: (number of cases with primary failure / total number of performed accesses) _ 100.
– Percentage of native avf used as a first vascular access: (number of native avf used as a first vascular access / total number of performed accesses) _ 100.
– Time to first use: time from access creation to central catheter withdrawal or first channeling if a catheter was not used.
– Fistulographies rate: (number of performed fistulographies / number of monitored accesses) _ 100.
– Intervention (surgical or radiological) rate: (number of surgical or radiological procedures performed) / (number of monitored accesses) / (number of years).
– Primary survival (non-assisted): time from first vascular access creation to need for a second procedure (fibrinolysis, percutaneous or surgical angioplasty) to maintain viability.
– Cumulative survival: time from vascular access creation to final failure.
– Thrombosis rate: (number of thrombosed accesses) / (number of performed accesses) / number of years.

Accesses have been prospectively followed from their creation to end of follow-up period or final situations. Patient death, functional renal transplantation, shifting to peritoneal dialysis, moving to another center, and study end with functional avf (December of 2002) were considered as such. Access survival is confirmed at the time of final situation.

STATISTICS

Data are described as means and 95% confidence interval (95%CI) for quantitative variables; and as frequency and percentage for qualitative variables. Actuarial analysis with Kaplan-Meier curves is used to study thrombosis-free survival and cumulative permeability, comparing the curves with the log-rank test. Thrombosis risk is estimated by means of a logistic regression model. Intervention and complications rates by means of Student's t test o chi-squared test, depending on the cases.

Statistical calculations are done with Statistical Package for Social Sciences (SPSS version 10.1) for Windows. Levels lower than 0.05 are considered significant.

RESULTS

During the recruitment period (from January 1998 to December 2001) a total of 164 vascular accesses were performed to 144 patients with end-stage CRF. Of these 164 cases, monitoring was done in 127: 6 patients (3 with diabetes mellitus, 1 with glomerulonephritis, 1 with systemic disease, and 1 with interstitial nephropathy) died before the creation and utilization of the avf. Three had a PTFE-E prosthesis (which represents 1.83% of prosthesis placement out of the total number of vascular accesses). Other 28 vascular accesses, done in 24 patients, were never functional, were insufficiently developed for use or got thrombosis before their use, representing 17.1% of primary failure out of the total number of native vascular accesses.

The 127 avf monitored were done in 113 patients, with a mean of 1.12 accesses/patient. As for CRF etiology: diabetes mellitus (n = 23), glomerulonephritis (n = 23), interstitial, AHT and hereditary nephropathies (n = 43), systemic disease and ischemic nephropathy (n =13), unknown (n = 25). Age was 63.3 ± 12.4 years.

Table I shows the number of previous avf, presence or absence of a central catheter and its position in relation to the avf created. The percentage of native avf used as a first vascular access in relation to total number of first vascular accesses was only 28.9%, the remaining being central catheters. The avf type most usually performed was left radial-cephalic, followed by left humeral-cephalic (table I). Time to first use was 37.9 days (95%CI: 29.8, 46.2), time to final failure was 395.9 days (95%CI: 286.4, 505.5), and follow-up time was 26.4 months (95%CI: 9.6, 26.9).

Table II shows diagnostic fistulographies, done in agreement with application of the monitoring protocol, and transluminal percutaneous angioplasty procedures for resolving detected stenoses. Out of the total number of performed fistulographies, only two

Table I. Number and percentage of previous vascular accesses, presence or absence of central catheter, and its location, and anatomic types of monitored vascular accesses (n = 127)

Num. of previous fistulae	
– 0	83 (65.1%)
– 1	27 (21.4%)
– 2	10 (7.9%)
– 3	5 (4.0%)
– 4	1 (0.8%)
– 5	1 (0.8%)
Central catheter	
– none	29 (22.6%)
– internal jugular vein	77 (61.3%)
– subclavian vein	21 (16.1%)
Central catheter location	
– ipsilateral to the arterial-venous fistula	28 (21.8%)
– contralateral to the arterial-venous fistula	70 (55.6%)
– no central catheter	29 (22.6%)
Type of arterial-venous fistula	
– left radial-cephalic	66 (52.0%)
– right radial-cephalic	10 (7.9%)
– left humeral-cephalic	25 (19.7%)
– right humeral-cephalic	6 (4.7%)
– left humeral-basilic	13 (10.2%)
– right humeral-basilic	7 (5.5%)

Table II. Number and percentage of monitored vascular accesses (n = 127) in which diagnostic fistulography and radiological or surgical intervention procedures were, or were not, made to maintain survival after their first utilization. Types of arterial-venous fistulae that presented thrombosis episodes throughout the follow-up period (% expresses the percentage over total number of monitored access types)

Fistulographies	
– none	83 (65.4%)
– one	33 (26.0%)
– two	10 (7.9%)
– three	1 (0.8%)
Transluminal percutaneous angioplasty	
– none	95 (74.8%)
– one	20 (15.7%)
– two	8 (6.3%)
– three	2 (1.6%)
– four	1 (0.8%)
– five	1 (0.8%)
Fibrinolysis	
– none	118 (92.9%)
– one	7 (5.5%)
– two	2 (1.6%)
Surgical procedures	
– none	104 (81.9%)
– proximal re-anastomosis	16 (12.6%)
– collaterals closure	2 (1.6%)
– basilic vein superficial positioning	4 (3.1%)
– saphenous vein graft	1 (0.8%)
Type of arterial-venous fistula with thrombosis	
– left radial-cephalic	19 (29%)
– right radial-cephalic	4 (40%)
– left humeral-cephalic	5 (20%)
– right humeral-cephalic	3 (50%)
– left humeral-basilic	5 (39%)
– right humeral-basilic	4 (57%)

did not show vascular pathology. In case of access occlusion, therapeutic fibrinolysis and/or other varied surgical procedures were performed to maintain its survival (table II). Closure was necessary in no accesses because of theft syndrome. Surgical operation rate was 0.03 surgical procedures/patient/year, radiological intervention rate was 0.10 percutaneous procedures/patient/year, and the global rate was 0.13 procedures/patient/year. Throughout the 5-year study period, there were 41 thrombosis episodes in 40 avf, which represent a thrombosis/access/year rate of 0.07 (table II). Of these 41 episodes, in 12 recanalization of the avf was successful (in 7 with fibrinolysis and in 5 with a more proximal re-anastomosis), without complications.

Table III shows the final outcome of patients carrying the monitored fistulae, including those that had non-recoverable thrombosis, and Table IV shows the Kaplan-Meier analysis for cumulative (Fig. 1) and primary survivals of all avf and their subtypes.

Logistic regression analysis for thrombosis risk (table V) demonstrated that, of all studied factors, central catheter presence at the time of the fistula creation represents a high risk of further thrombosis of the latter. This risk is over 5 fold higher in case the catheter location was the subclavian vein. Regression analysis comparing central catheters with each other showed that the subclavian route has a 3.1 fold higher risk of later avf thrombosis than the jugular route (95%CI: 0.91, 5.96) (fig. 2).

DISCUSSION

Vascular access failure is an important morbidity cause in HD patients, representing a high percentage in total admissions for access-related complica-

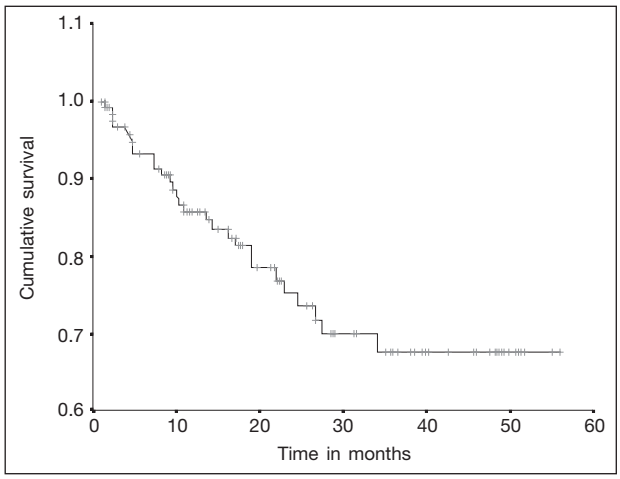

Fig. 1.—Cumulative survival of arterial-venous fistulae throughout the study (n = 127).

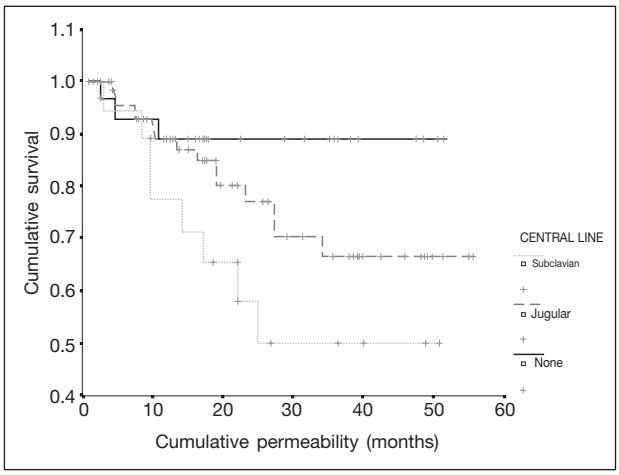

Fig. 2.—Cumulative survival of arterial-venous fistulae depending on absence of central vein catheter (n = 29), internal jugular vein catheter (n = 77), and subclavian vein catheter (n = 21).

tions[1-4]. It has been demonstrated that quality of life and prognosis in these patients can significantly be improved by achieving an increase in the total number of native vascular accesses performed and by detecting access dysfunction before thrombosis occurs[14,16]. The early DOQI guidelines[5], and their further up-date[13], recommend that centers establish monitoring programs in order to detect risk for vascular access failure, and quality assurance.

We present a prospective study of all «native» vascular accesses created at our Center during the last 5 years. It has been recommended that at least 50% of new HD patients should have primary avf, 40% of prevalent patients carrying a native vascular access[13]. A study done in Spain on a high number of patients, with age and diabetes prevalence similar to our population, shows a percentage of autologous avf utilization of 61.3% and 38.6% for prostheses[17]. In 1999, the Vascular Access Working Group (VAWG) undertook a cross-sectional study by sending a questionnaire to hemodialysis units in our Country[18]. In the 5,472 included patients sample, HD was done through an avf in 80%, through a catheter in 11%, and through grafts in 9%[18]. The prospective and observational DOPPS study (Dialysis Outcomes and Practice Patterns Study) was performed in the United States, Japan and five European countries, which included Spain[19]. In the total population sample, 17,236 patients randomly selected with a mean age of 60.5 years, the more prevalent vascular accesses were native avf (54.7%), synthetic grafts (24%), permanent catheters (12%), and temporary catheters (9.3%)[19]. Analyzing the group of European countries, known as Euro-DOPPS, the population of our study can be superimposed to the one included in the former, and the same happens with the Spanish subgroup, with 936 patients with a mean age of 60.9 years and a diabetes prevalence of 19.6%[20-22]. However, in the cited study the percentage of native avf utilization, in prevalent patients, still remains lower than ours (80%), the percentages of grafts (10%) and catheters (8%) being higher[20,22]. In our population, the data on native avf performed were over 90% of the total accesses, which occurs in only 31% of the dialysis units participating in Euro-DOPPS[22].

Table III. Final outcome of patients carrying a monitored arterial-venous fistula (avf) (n = 127), included those that presented irreversible thrombosis (n = 28) (% expresses the percentage over total number of monitored accesses)

Shifting to peritoneal dialysis	4 (3.1%)
New native avf	21 (16.5%)
Permanent catheter	3 (2.3%)
Transplantation (functional avf)	24 (18.9%)
Death (functional avf)	17 (13.4%)
Center change (functional avf)	2 (1.6%)
End of follow-up period (functional avf)	56 (44.1%)

Table IV. Kaplan-Meier analysis of cumulative and primary survival of monitored arterial-venous fistulae (avf) (n = 127), expressed as mean and 95% confidence interval (CI)

	Cumulative survival (months)	95% CI	Supervivencia primaria (meses)	I95% CI
All avf (n = 127)	42.78	38.67, 46.88	30.31	25.60, 35.02
Left radial-cephalic (n = 66)	44.76	39.36, 50.16	31.37	24.77, 37.98
Right radial-cephalic (n = 10)	28.51	17.07, 39.95	26.12	10.62, 41.62
Left humeral-cephalic (n = 25)	43.27	36.56, 49.98	32.41	24.65, 40.17
Right humeral-cephalic (n = 6)	37.67	17.98, 57.35	14.23	8.34, 20.13
Left humeral-basilic (n = 13)	31.78	19.61, 43.94	17.36	7.80, 26.92
Right humeral-basilic (n = 7)	37.19	23.35, 51.02	24.26	14.02 , 34.51

Among native vascular accesses, avf created in the cephalic, radial-cephalic or humeral-cephalic veins have some advantages: excellent survival; lower percentage of occlusions once developed; lower morbidity associated to their creation and a better performance over time[9-12, 23-25]. Consequently, our protocol establishes, in the first place, the creation of radial-cephalic avf, if possible, in the non-dominant limb, and humeral-cephalic in the second place. For this reason, cephalic vein avf represented almost 84% of the total performed. This issue might have contributed to the primary failure rate, since 61% of the never used avf were left radial-cephalic. As drawbacks of these types of accesses, the following have been reported: a greater percentage of maturation failure, long time periods for their development, and a greater cannulation difficulty[11-12, 23]. A 7-year prospective study, which also considers the radial-cephalic avf as the preferable vascular access followed by the humeral-cephalic as opposed to prostheses, reported primary failure rates of 31.5%, 28%, and 22.6%, respectively[25].

One of our goals was to develop and implement a monitoring protocol aiming at early, before thrombosis appearance, detection of autologous accesses stenosis by using the available methods in the Department hemodialysis units. In the case of vascular prostheses, it has been shown that prospective monitoring for detection of hemodynamically significant stenoses, combined with their repair, improves survival and decreases thrombosis incidence (5-8, 26). However, there are no similar studies on native avf and although the methods used to detect prosthesis stenosis do not seem to be as effective for avf, the current opinion is that they should be equally monitored[13, 26]. The VAWG study reported that most units carried out a periodic assessment of accesses, being the most performed practice, in 70% of the cases, the detection of physical changes[18]. According to Euro-DOPPS data, clinical monitoring of vascular accesses is accomplished in 75% of the centers, in 52% by ultrasound[20]. In our study, a monitoring program was established based on physical examination of vascular accesses and on indirect flow and pressure measurements, by using the means available in any dialysis unit. With a moderate surgical and radiological intervention rate, lower than the one reported by others in autologous avf within 5 years[17], and a good relationship between number of fistulographies and number of performed angioplasties, we managed to detect and correct stenosis in a high number of native vascular accesses.

Another DOQI guidelines proposal is the establishment of quality assurance programs for vascular accesses[13]. Quality control lies in continuous assessment of the quality degree of a particular element of the attending process, and the tools it uses are several clinical indicators. Quality assurance represents a further step, trying to assure the quality of an already evaluated element. It is characterized by the implementation and/or execution of the correcting measures suggested in evolution and control processes. DOQI guidelines suggest as clinical indicators the percentage of autologous avf as a first vascular access, the follow-up of vascular accesses complication rates, their underlying causes and their survival. With regards to the native avf primary failure rates (for example, during the first 30 days) and

their cumulative survival, these guidelines consider that they should not be used as quality indicators[13]. The rationale for this is that their use might lead to a decrease in native avf creation in patients with complex vascular anatomy and, therefore, with a greater failure risk. However, these two indicators should be used and be part of the quality assurance program for vascular accesses in dialysis centers[13].

In this study, the bases for a quality assurance program in our Center using several indicators are established. Among these indicators, we have already discussed the high percentage of native avf and the moderate primary failure rate. On the other hand, the 5-year cumulative survival was near 70%, which is similar, or even higher, than the one reported for native vascular accesses by other authors[17, 25]. It has been proposed that another indicator, the thrombosis rate for autologous avf, should be less than 0.25 episodes/patient/year (after adjusting for early failures, for example the first two months)[13]. In our population, and without adjustment, it was much lower, with 0.07 episodes/patient/year. These latter results are in agreement with those of a recent work on monitoring native vascular accesses, although it only used flow measurement ultrasound dilution techniques[27]. Although its results benefit from exclusion of those avf with failure within the first two months and shorter follow-up time, one- and two-year cumulative survival rates are similar to ours, being the same for thrombosis rate (0.08 episodes/patient/year)[27].

The present analysis on thrombosis risk demonstrated, similarly to other studies[25, 28], that age, diabetes as basal disease, the number of previous avf and their different anatomic types, were none of them associated to a greater risk. It happened similarly with time to first use that again agrees with the DOPPS study contributions, in which it can be observed a higher failure relative risk for only those avf channeled within 14 days of their creation[28]. On the other hand, in our analysis the presence of a subclavian vein catheter confers an avf thrombosis relative risk five fold higher. This fact, not unexpected[29], is of concern because of the high incidence of central catheters utilization as a first vascular access and as a bridge until the first use of the avf[22,30]. In our representative Spanish sample, its use has been reported in 44% of the first HD sessions[18]. The DOPPS study also reveals elevated numbers, although with differences (61% in the USA, 50% in the UK, and 26% in Spain)[22, 28]. In relation to their anatomical location, in countries included in Euro-DOPPS, 15% to 18% of channeled or temporary catheters were in the subclavian vein[22]; the study showed a higher avf failure risk in those patients that had had a previous catheter as a temporary access[22, 28].

Table V. Logistic regression analysis of thrombosis risk for monitored arterial-venous fistulae (n =127) and 95% confidence interval (CI)

	Relative risk	**95% IC**	**p**
Age	1.02	0.98, 1.05	0.346
Diabetes mellitus	1.51	0.59, 3.86	0.386
Central line			
– jugular	1.87	0.63, 5.56	0.257
– subclavian	5.6	1.52, 20.80	0.010
Central lide side	2.28	0.91, 5.69	0.079
Number of previous fistulae	0.99	0.98, 1.01	0.317
Number of previous fistulae	1.19	0.81, 1.74	0.371
Type of fistula			
– right radial-cephalic	1.65	0.42, 6.51	0.475
– left humeral-cephalic	0.62	0.20, 1.89	0.398
– right humeral-cephalic	2.45	0.46, 13.36	0.293
– left humeral-basilic	1.54	0.45, 5.33	0.490
– right humeral-basilic	3.30	0.67, 16.16	0.141
Transluminal percutaneous angioplasty	2.05	1.24, 3.38	0.005

Finally, performing angioplasty procedures in fistulae with stenosis was associated with an access thrombosis risk twice higher. This should not be considered as an angioplasty effect per se, but it highlights, once again, the importance of early detection of the stenosis and its resolution, since it is the main factor for triggering thrombosis (6a-7a). It has been observed in native avf, already studied within the first two months of HD onset, a high incidence of early stenoses and a recurrence of these angioplasty-treated lesions (r-2). This outlines the importance of monitoring vascular accesses from the onset of dialysis and the need for pursuing it, even after stenosis correction.

In conclusion, in our HD population, characterized by an advanced age in most of the patients and an important prevalence of diabetics, the creation of functional avf is feasible in almost all patients. Although radial-cephalic avf are associated with a high rate of primary failure, their survival is excellent, with a low rate of complications. In this 5-year prospective study, the developed monitoring protocol, using methods available at the dialysis units, allowed the detection and correction of stenosis in many native vascular accesses. In a high percentage of native avf with thrombosis, recanalization of the occluded access was possible, so it should be tried whenever it is feasible. The greatest detected risk for avf thrombosis is the presence of a subclavian venous catheter prior to the creation of the avf. This procedure should be avoided.

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