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Epidemiological study of 7316 patients on haemodialysis treated in FME clinics in Spain, using data from the EuCliD® database: results from years 2009-2010

Rafael Pérez-García[1], Inés Palomares-Sancho[2], José I. Merello-Godino[2], Pedro Aljama-García[3], Jesús Bustamante-Bustamante[4], José Luño[5], Francisco Maduell-Canals[6], Ángel L. Martín-de Francisco[7], Alejandro Martín-Malo[3], Eduard Mirapeix-i-Vicens[6], Manuel Molina-Núñez[8], Manuel Praga-Terente[9], Ciro Tetta[10], Daniele Marcelli[11]; Grupo ORD (Optimizando Resultados de Diálisis)*

[1] Servicio de Nefrología. Hospital Universitario Infanta Leonor. Madrid (Spain)
[2] Dirección Médica. Fresenius Medical Care. Madrid (Spain)
[3] Servicio de Nefrología. Hospital General Universitario Reina Sofía. Córdoba (Spain)
[4] Servicio de Nefrología. Hospital Clínico Universitario de Valladolid (Spain)
[5] Servicio de Nefrología. Hospital General Universitario Gregorio Marañón. Madrid (Spain)
[6] Servicio de Nefrología. Hospital Clínic de Barcelona (Spain)
[7] Servicio de Nefrología. Hospital Universitario Marqués de Valdecilla. Santander (Spain)
[8] Servicio de Nefrología. Hospital Universitario Santa Lucía. Cartagena, Murcia (Spain)
[9] Servicio de Nefrología. Hospital Universitario 12 de Octubre. Madrid (Spain)
[10] Strategic Medical Board. Fresenius Medical Care. Bad Homburg (Germany)
[11] Nephrocare Coordination. Fresenius Medical Care. Bad Homburg (Germany)

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ABSTRACT

Observational study of patients on haemodialysis (HD) in FMC® Spain clinics over the years 2009 and 2010. Data was collected from the EuClid® database, implemented in the FMC® clinics, which complies with the following features: online record, mandatory, conducted in incident patients and covering the entire population on HD in these clinics. It aims to understand the characteristics of patients and treatment patterns, comparing them with other studies described in the literature and in order to improve their prognosis and quality of life. It includes 2637 incident and 4679 prevalent patients, which makes a total of 7316 patients. In prevalent patients: 24.4% were diabetic; 76.3% had cardiovascular disease (CVD) and 13.4% cancer. Among the incident patients these percentages were: 33.5% diabetic; 80.6% had CVD and 12.6% cancer. The prevalent patients had vascular access such as: AVF 68.5%, prosthesis 5.6%, permanent catheter 23.7% and 2.3% temporary catheter. The average duration of the sessions of HD was 230 minutes. 23.2% of prevalent patients were on on-line haemodiafiltration. These patients' hospitalisation rates were 0.46 hospitalisations per incident patient per year and 0.52 per prevalent patient per year. The annual gross mortality rate was 12%. The mortality of HD patients in this study is smaller than those of the Spanish Registry of Dialysis and Transplant (GRER). The result of morbidity and mortality of the FMC clinics of Spain can, therefore, be considered good when compared with those of the GRER and other international series. This does not mean that there are no areas of improvement as the increase in the dialysis time, the

Correspondence: Rafael Pérez García
Servicio de Nefrología.
Hospital Universitario Infanta Leonor, Madrid. (Spain).
rperezgarcia@senefro.org
joseignacio.merello@fmc-ag.com

* The authors form part of group ORD (Optimising Results in Dialysis).

percentage of patients on on-line haemodiafiltration, convective techniques and the percentage of FAV.

Keywords: Haemodialysis. Morbidity. Mortality. Epidemiology. Diabetes.

Estudio epidemiológico de 7316 pacientes en hemodiálisis tratados en las clínicas FME de España, con los datos obtenidos mediante la base de datos EuCliD®: resultados de los años 2009-2010

RESUMEN

Estudio observacional de los pacientes dializados en las clínicas de Fresenius Medical Care en España (FME) durante los años 2009 y 2010. Los datos se recogen de la base de datos EuCliD®, implementada en las clínicas FME, que cumple con las siguientes características: registro en línea, obligatorio, realizado en pacientes incidentes y que abarca a toda la población en hemodiálisis (HD) atendidos en esas clínicas. Su objetivo es comprender las características de los pacientes y los patrones de tratamiento, comparándolos con otros estudios descritos en la literatura y con el fin de mejorar su pronóstico y calidad de vida. Se incluyen 2637 pacientes incidentes y 4679 prevalentes, lo que hace un total de 7316 pacientes. Un 24,4 % de los pacientes prevalentes eran diabéticos, un 76,3 tenían antecedentes de enfermedad cardiovascular (ECV) y un 13,4 % de cáncer. Entre los incidentes estos porcentajes eran: 33,5 % diabéticos; 80,6 % habían presentado ECV y el 12,6 % cáncer. Los pacientes prevalentes tenían como acceso vascular: fístula arteriovenosa (FAV) 68,5 %, prótesis 5,6 %, catéter permanente 23,7 % y catéter temporal 2,3 %. El promedio de la duración de las sesiones de HD era de 230 minutos. Un 23,2 % de los pacientes prevalentes estaban en técnica de hemodiafiltración en línea. Los índices de hospitalización de estos pacientes son bajos: 0,46 hospitalizaciones por paciente incidente y año y 0,52 por paciente prevalente y año. La tasa de mortalidad bruta anual es de un 12 %. La mortalidad de los pacientes en HD de este estudio es menor que la del Registro Español (GRER). El resultado de morbilidad y mortalidad de las clínicas FME se puede, por tanto, considerar como bueno en comparación con el del Registro Español de Diálisis y Trasplante y de otras series internacionales. Eso no quiere decir que no haya áreas de mejora, como el aumento del tiempo de diálisis, de las técnicas convectivas y del porcentaje de FAV.

Palabras clave: *Hemodiálisis. Morbilidad. Mortalidad. Epidemiología. Diabetes*

INTRODUCTION

Life expectancy of chronic kidney disease patients on haemodialysis (HD) is very short compared to the general populations'.[1-3] In the last few years, despite the technical advances in HD, survival rates have not improved. The cause is that age and comorbidity of these patients is increasing. On the other hand, there are notable differences in morbidity and mortality among countries. Thus, even when adjusted for age and comorbidity, mortality is higher in the U.S. than in Europe; in Japan it is still lower. Therefore, it should be interesting to compare the epidemiology of this population and the treatment methods among the different countries. Great prospective observational studies, like the Dialysis Outcomes and Practice Patterns Study (DOPPS)[3] and the United States Renal Data System Dialysis Morbidity and Mortality Wave II[4,5] have provided numerous data and valuable information about which clinical HD practices show the best results. In Europe, there are also many epidemiological prospective studies that describe the incident HD population.[6-12] In Spain, we have the ANSWER study, carried out in 2341 HD incident patients during 2003 and 2004.[13-15]

The methodology used in the studies is fundamental when it comes to evaluating the validity of the findings and extrapolating the results to other populations. Records that require data to be collected online and that are mandatory are of great value. In general, prospective studies in incident patients are easier to interpret than those carried out with prevalent cohorts of patients. The sample population is another important factor. Studies that collect data from all the population, as opposed to a sample, avoid the inherent disadvantages of the sampling technique. The EuCliD® database, implemented in the Fresenius Medical Care in Spain (FME) fulfils all of these requirements: mandatory online registry and includes all the HD population on their clinics. The EuCliD® database has given rise to many publications with these characteristics.[16-21]

The main objective of this observational study of dialysed patients on the FME clinics is to understand the clinic's characteristics and treatment methods, comparing them with other studies from the literature and in order to improve patients' prognosis and quality of life.

METHOD

Observational descriptive study on HD patients in FME clinics in 2009 and 2010. Among the epidemiological data described are: demographic characteristics, personal and comorbidity history, dialysis and vascular access characteristics, laboratory data, medication received and data on patients' evolution during follow up (see list of variables of interest).

Patient selection

We included all patients with chronic kidney disease on a HD programme from all FME clinics. We put together all incident and prevalent patients during 2009 and 2010 that

were registered on the EuCliD® database. Prevalent patients have been defined as the ones registered as of 1 January, 2009 who had been on HD more than three months. Incident patients are defined as patients that started HD in a FME clinic since October 2008 and that have been followed up for at least 3 months. We have accounted for all causes of loss of follow up, including functioning kidney transplant, transfer to another technique (peritoneal dialysis [PD]), transfer to another facility, death (both patients who died while under the responsibility of the dialysis centre, those who died during hospitalisation or those who were transferred and died in three months) and other losses of follow up

EuCliD® database

Our database was created from the data of patients included in EuClid® (**Eu**ropean **Cli**nical **D**atabase of Fresenius Medical Care). EuCliD® is an information tool developed to monitor the treatment of patients in Fresenius clinics in Europe, the Middle East, Africa and Latin-America.[22,23] All patients whose data are included on EuCliD® sign the appropriate consent form. The database complies with the regulations for information protection. Data on dialysis treatment (HD and PD) including medication during treatment and at home, as well as incident and comorbidities, are registered prospectively. EuCliD® is based on two main databases: the EuCliD® tables and the database itself. The tables contain extensive information that includes, for example, the codification of diseases ICD 10 (International Classification of Diseases) from the World Health Organisation, the ATC code (Anatomical Therapeutic Chemical Classification System) for treatment with medication, its own codes for diagnostic trials, laboratory trials and consumables used. The tables are similar in all the centres that use EuCliD® regardless of the country. Besides the tables, EuCliD® includes the database itself, which gives it great value. It contains patients' demographics, history, physical examination, comorbidities, laboratory data and tests, treatment medication and dialysis, treatment follow up, inputs and outputs for different reasons (hospitalisation, transplantation, recovery of renal function, death, etc.) and their causes. EuCliD® is based on a Lotus Domino server and Notes Client Platform, a computer program recognised worldwide for its ability to store great volumes of information. Access to EuCliD®, properly protected, takes place online and allows us to design different levels of access to information according to the user's profile. This database has been used for previous epidemiological studies.[16-23]

All patients included in the EuClid® registry are required to sign a consent form for the utilisation of their information in compliance with the Agency for Data Protection regulations.

Variables of interest

Number of centres with patients included, total number of studied patients, incident patients and prevalent patients. Epidemiological characteristics (incident and prevalent patients): start date of dialysis in FME centre, age at the start of dialysis, sex, aetiology of renal disease according to ICD 10, accompanying diseases according to ICD 10, body mass index (BMI)(first available during this time), weight and height (first available during this time) and time on dialysis. With respect to dialysis (incident and prevalent patients): type of vascular access (%), native arteriovenous fistula (AVF), arteriovenous fistula prosthesis (graft), permanent catheter (tunnelled) and temporary catheter (not tunnelled). Dialysis characteristics (6 months average): blood flow (ml/min), session duration (minutes), session frequency, dialysis technique: HD or post dilution on-line haemodialfiltration (OL-HDF), dialysis dose calculated according to eKt/V (applying Daugirdas 2nd generation formula and applying his correction for the urea rebound). Analytical data (incident and prevalent patients, average of 6 months): haemoglobin (Hb), transferrin saturation index, ferritin, total calcium, phosphorus (P), parathyroid hormone, C-reactive protein, albumin and total cholesterol. Treatments: incident and prevalent patients (at some point in evolution): erythropoiesis-stimulating agents (ESAs), insulin, oral antidiabetics, antihypertensive drugs, angiotensin-converting enzyme inhibitors (ACEIs), statins, phosphate binders, oral vitamin D (calcitriol, paricalcitol, vitamin D native), cinacalcet. Progression data: incident and prevalent patients.

We recorded the following as date of patient termination in the study: death, transplant, transfer, treatment interruption, other losses of follow up or study closing failing. Follow-up time: the time from the start of tracking prevalence or incidence to date of termination. We considered as death all patients who died while under the responsibility of the dialysis centre, or during hospitalisation or those who were transferred and died within three months. Causes of death: cardiovascular (CV), sudden death or at home, infectious, and tumours among others. Hospitalisation: inpatient percentage per year, duration of hospitalisation.

Method for calculating mortality rate: the mortality rate was calculated for the years 2009 and 2010 by means of a proportion, as used in the records of Andalusia, Asturias, Catalonia and the Basque Country (F1, Figure 1). We have also calculated it using a ratio, as in the records of Castilla y León and Valencia (F2, Figure 1). Finally, it was also calculated as a density index of mortality, just as it is done in the Canary Islands (F3, Figure 1). In the latter case, the periods were 2009 and 2010. This methodology is used by the Spanish Registry of Dialysis and Transplantation (GRER)

for data processing of the Annual mortality registry, although the methodology is different, the results are comparable.[24]

Statistics

Qualitative variables are shown as percentages and quantitative variables as mean (and standard deviation). For comparison of qualitative variables, χ^2 test was used. Values of P <.05 were considered to be statistically significant. The analysis was performed using SPSS software version 19 (SPSS Inc. Chicago IL).

RESULTS

Population Characteristics

Population is composed of 2637 incident patients and 4679 prevalent patients; which makes a total of 7316 patients included in this study. 62.7% are male and 37.3% female. This male dominance is greater in the incident patients, 64.4%, than in the prevalent population, 61.7%. The mean age is 64 (15.1) years. It is slightly higher in incident patients (65 [15.4] years) than in prevalent patients (63.5 [14.9] years). Women were slightly older than men in both the incident and the prevalent patients (P=.021).

In incident patients (2637) the cause of chronic renal disease was: diabetes 22.9%, vascular nephropathy 13.9%, glomerulonephritis 11%, chronic interstitial nephropathy 9.8%, hereditary nephropathy 8.4% and 4% other causes. In 30% of cases, the cause was not specified or known. In prevalent patients (4679), the cause of chronic kidney disease was: diabetes 17.2%, vascular nephropathy 12.5%, glomerulonephritis 11%, chronic interstitial nephropathy 11%, hereditary nephropathy 8% and 4.5% other causes. In 35.8 % of cases, the cause was not specified or known.

Incident patients' (2637) BMI was 26.8 (6.4) kg/m^2 and in prevalent patients (4679) it was 26.3 (5.3) kg/m^2. Among prevalent patients (4679), 24.4% had diabetes, 76.3% had a history of cardiovascular disease (CVD) and 13.4% cancer. At any point during the study, 33.5% of incident patients had diabetes; 80.6% had presented CVD and 12.6% cancer.

Characteristics of dialysis and vascular access

59.2% of incident patients had an AVF, 1.8% graft, 32.1% had a permanent catheter and 6.9% a temporary catheter. Among prevalent patients, the percentages were: 68.5% AVF, graft 5.6%, 23.7% permanent catheter and temporary catheter 2.3%. Differences between both groups were statistically significant with a P-value <.001. Table 1 lists some features of HD. 23.2% of prevalent patients and 9.6% of incident patients are treated with OL-HDF. The average value of calcium in dialysate was 1.39 (0.13) mmol/l.

Analytical controls and treatments received

Table 2 displays the distribution of patients according to their Hb level, bone mineral metabolism parameters and other biochemical data. Table 3 registers the percentage of patients on treatment with: ESA, statins, ACE inhibitors, other antihypertensives, insulin, oral antidiabetics, oral vitamin D, phosphorus binders and cinacalcet. The difference in the use of treatment whether it was incident or prevalent patients were statistically significant (P=.001 in the case of statins and P<.001in the rest of cases).

Mortality and morbidity

On 2009, 523 incident patients were admitted to hospital at least once, and in 2010, 690 patients were admitted. In total, during both years, 46% of incident patients were admitted to the hospital; among prevalent patients, 2403 were admitted during the two-year studied period (52.2% [P<.001]. The average number of hospitalisation days was 10.7 for incident patients and 11.5 for prevalent patients. Together, the average (7316) was 11.2 hospitalisation days.

F1

$$\text{Mortality} = \frac{\text{Patients deceased that year}}{\text{Prevalent patients as of 31 December + patients decea that year}}$$

F2

$$\text{Mortality} = \frac{\text{Patients deceased that year}}{\text{Prevalent patients as of 31 December}}$$

F3

$$\text{Density of mortality} = \frac{\text{Number of patients deceased within a predetermined time period/}}{\text{sum of risk periods of each patient along the specified period}}$$

Figure 1. Method of calculating mortality index

During the two years studied, 990 prevalent patients and 248 incident patient passed away; in total, 1238 out of 7316 patients died. Among incident patients, the causes of death were: 29.6% CV, sudden death or unknown cause 19.3%, 9.4% infectious, 7.6% cancer. Among prevalent patients, causes of death were: 30.5% CV, sudden death or unknown cause 24.9%, 6.1% infectious, 5.2% cancer. An annual 4.2% of patients discontinued treatment: 14 patients in 2009 and 26 in 2010 changed to PD technique.

The mortality rates obtained through the formulae used by the GRER[24] give the following results: F1, F2, F3 2009 (10.8 %, 12.2 %, 11.9 %) respectively; F1, F2, F3 2010 (11.6 %, 13.1 %, 11.9 %) respectively (Table 4). Moreover, these differences are maintained in the stratification by age group for both periods (Figure 2).

During the controlled period, 179 incident patients (6.8%) and 478 prevalent patients (10.2%) received a transplant. The annual average of transplants was 4.5%. 4.2% of patients per year were transferred, 22 patients were lost for follow up due to unknown reasons and treatment was discontinued in 20 patients.

DISCUSSION

In 2009, the 4679 prevalent patients on HD who were recruited in this study represent 20.2% of prevalent patients on HD in Spain. That year, Spain had 1039.4 prevalent patients on renal replacement therapy per million population, 47.67% of which were on HD.[25] In 2010, the prevalent patients included in this study accounted for 22.8% of the population on HD in Spain.[26] They represent, therefore, a large sample of the total population. At the same time, it is a peculiar sample because they belong to outpatient HD centres, while the general population includes both hospital and outpatient units. HD patients treated on HD hospital centres would represent 41.67% (source: Annual Market&Competitor Survey FME 2011).

With respect to HD incident patients, those recruited during 2009 in this study represent 25.8% of the total population and 21% of it during 2010. These percentages are similar to those of the prevalent patient population.

How are the patients in our study similar or different to the rest of patients in Spain? How are they with respect to age, gender, and comorbidity?

We can suppose that, since they belong to outpatient services, they would be younger and with less comorbidity. However, their mean age is 64 years old in the prevalent patients and 65 in the incident patients in this study, which is similar to that of other studies in Spain: 65.2 years in the ANSWER study, 62 years in the study referred by the Nephrology Department of the Hospital Gregorio Marañón in Madrid[27], 61.5 years for incident patients and 66.1 for prevalent patients in the SEN Quality Group Revision.[28] These studies include in-patient and outpatient HD patients. In the ARO study[21], which includes several European countries, including Spain, the mean age is 65, though it varies by country. It is a shame that the GRER does not provide this data with a concrete number.

The relation between men and women is 1.7 among prevalent patients and 1.8 among the incident patients. This ratio is equal to the ANSWER[13] study (1.7) which included hospitalised patients, and GRER's 2006 ratio of 1.74.[29] This predominance of men appears also, though less marked, in France (1.43), Italy (1.45) and Portugal (1.48), while not in countries like the Czech Republic (0.98) or Hungary (0.97).[21] Male dominance may contribute to increased cardiovascular risk and mortality, although in some studies females have been associated with increased risk of cardiovascular death in HD.[15,30]

The two leading causes of renal failure and starting of dialysis of this study patients are diabetes, 22.9%, and vascular causes, 13.9%. In the GRER data from 2009,[25] these percentages are 21.5% and 13.9%, respectively. In 2010 they accounted for 24.7% and 14.2%.[26]

Table 1. Characteristics of haemodialysis treatment (at 6 months)

Characteristics of Haemodialysis (at 6 months)	Incident patients	Prevalent patients
QB (mL/min)	365.54±67.36	391.36 ± 67.75
eKTV	1.36 ± 0.31	1.48 ± 0.29
Dialysis effective time (min)	224.53 ± 18.53	229.84 ± 17.89
Percentage of patients in OL-HDF (%)	9.59	23.19
Volume of infusion in OL-HDF (L)	19.22 ± 4.12	21.12 ± 4.28

OL-HDF: online heamodiafiltration; BF: blood flow

Table 2. Analytical controls (At 6 months)

Haemoglobin range (g/dl)	Incident patients	Prevalent patients
≤ 10	14.70 %	7.55 %
> 10-11	18.90 %	14.49 %
> 11-12	27.30 %	30.14 %
> 12-13	22.29 %	29.44 %
> 13	16.80 %	18.38 %
Laboratory		
Calcium (mg/dL)	8.94 ± 0.71	9.07 ± 0.67
Phosphorus (mg/dL)	4.66 ± 1.44	4.56 ± 1.37
iPTH (ng/dL)	295.72 ± 288.8	321.77 ± 318.15
Ferritin (µ/dL)	353.59 ± 342.25	449.99 ± 318.08
PCR (mg/L))	14.11 ± 25.81	13.08 ± 24.87
Albumin (g/dL)	3.84 ± 0.50	3.93 ± 0.50
Cholesterol (mg/dL)	161.44 ± 41.60	155.25 ± 37.76

iPTH: intact parathyroid hormone; PCR: C-reactive protein

If, among prevalent patients, those with diabetes in the GRER represent 14.3% in 2009 and 14.8% in 2010,[25,26] then this group accounted for 25.13%. As in the ANSWER study, the frequency of diabetes as a concomitant disease was 10% higher than diabetic nephropathy as the cause for renal failure.[13] Among the incident patients of our study, this percentage increases to 33.45%; this number represents the gradual increase of diabetics within the HD population in Spain. We must not forget that diabetes is a factor that increases the risk of death in the dialysis population.[11,31,32]

CV history is a fact of poor prognosis.[15] Approximately, a third of patients who start HD in Spain suffer a CV event during the first two years.[15] These events are more frequent and more lethal among patients with a previous history of CV events. In the ANSWER study, 44.9% of patients had a history of cardiovascular events, while in our study 76.3% had it. The difference is probably due in part to differences in definition and CVD event and in the EuCliD® documentation method. In the ARO study, with its definition of "disease", this same percentage was 73%. On the other hand, certain vascular pathologies are underestimated in the clinics, for example peripheral vascular disease. In studies designed to value this pathology, it reaches 39.5%.[27]

The previous history of tumour of 13.4% is higher that the 10% in the ANSWER[13] and the ARO study (5%-11%); it seems, again, that the EuCliD® documentation criteria may be one of the reasons for these differences.

Table 3. Medication

Percentage of patients treated at any point of this study with:	Incident patients	Prevalent patients	P value
Erythropoiesis stimulating agents	97.42%	92.67%	<0.001
Statins	57.84%	53.32%	0.001
ACE inhibitors	44.71%	34.17%	<0.001
Other anti-hypertensives	76.56%	60.31%	<0.001
Insulin	22.49%	16.52%	<0.001
Oral antidiabetics	4.21%	2.50%	<0.001
Oral vitamin D	61.60%	66.87%	<0.001
Phosphate binders	79.83%	82.62%	<0.001
Cinacalcet	26.53%	41.74%	<0.001

Percentage of patients that receive the corresponding drug at any point in the time period of the study.

ACEi: angiotensin converting enzyme inhibitor

Table 4. Mortality index

Mortality Index	2009		2010		
F1	(615/5675)	**10.8 %**	(623/5391)	**11.6 %**	Records from Andalusia, Asturias, Catalonia and Basque Country
F2	(615/5060)	**12.2 %**	(623/4768)	**13.1 %**	Records from Castilla y Leon and Valencia Community
F3	(615/5177)	**11.9 %**	(623/5221)	**11.9 %**	Records from the Canary Islands

BMI in HD patients is inversely related to mortality, opposite to the general population.[15] It is an example of "inverse epidemiology" which comes from the existence of other death risk factors that act as confounding factors at the statistical level.[15,33] In this study, BMI, which is 26.8-26.3 is in the high range of the ARO's study in which BMI varies between 24.8 and 26.5 in European countries.

On our study the population follows a classic pattern with respect to vascular access. A high percentage of incident patients start HD with a catheter (39%) and some of them have a native AVF performed later. Among prevalent patients, the native FAV percentage reaches 68.5%, a significantly lower number than the 78.4% mean for European countries.[21] This percentage is similar to a recent study in the Canary Islands, with 67%,[34] and higher than a study in Madrid with 47% of patients with catheters. These patients had a risk of death of 1.86 times compared to a native AVF carriers.[35] The presence of a catheter for vascular access is an independent risk factor for mortality, even adjusted for age, BMI, Karnofsky and Charlson index, duration of HD sessions, weight gain between dialysis sessions and various biochemical parameters in the ANSWER study.[15] The percentage of native AVF in this study is low. In Spain, as in other countries, an effort is being made to improve vascular accesses for HD.[28]

There are factors of HD that may be related to a higher HD survival rate, such as: high-flux polysulfone membranes in diabetic patients with low albumin; OL-HDF, with more than 20l of infusion per session; HD length greater than 4 hours, less interdialytic weight gain and higher eKt/V.[15,32,36,37] In a multicentre study conducted in 2007 with 2526 HD patients in Spain, both in hospital and outpatient units, 89% of patients were on conventional HD, 56.7% with high-flux membranes and medium blood flow 348.4ml/min.[28] In our series, the proportion of patients with high-flux polysulfone membranes (99.9%), OL-HDF patients (23.2%) and other parameters listed is higher than in many HD units. Blood flow (386.48ml/min) and eKt/V (1.47) obtained are above the mean in Spain and the mean for the ARO study.[21] In the Madrid region, the proportion

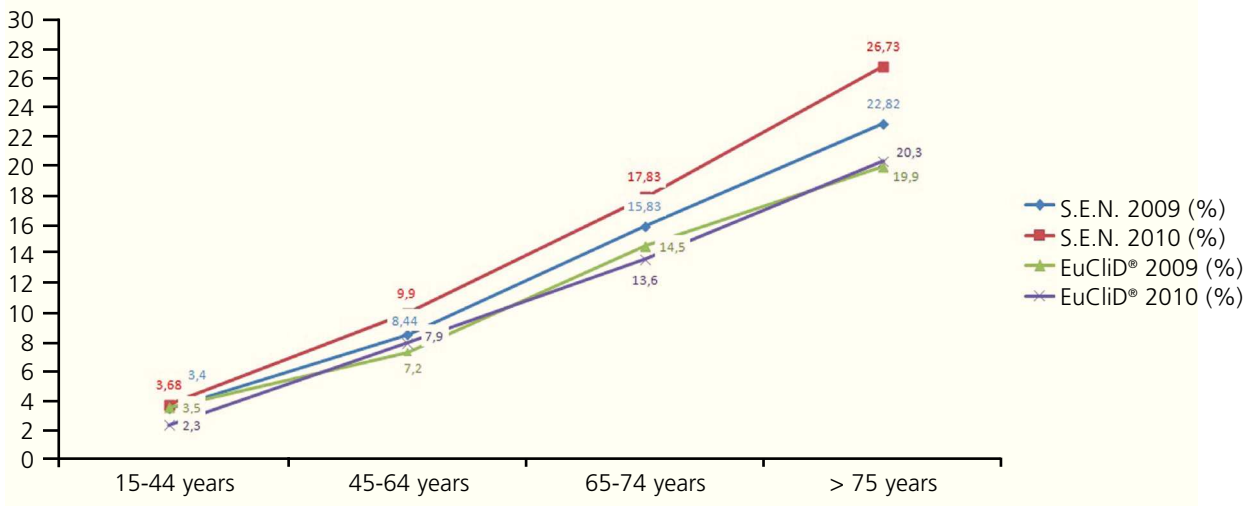

Figure 2. Mortality by ages, between 2009 and 2010.

of patients in OL-HDF is 8.5%, associating this technique to better results in dialysis.[37] The high prevalence of OL-HDF in FME clinics is due to the belief by many Spanish nephrologists that this is a more complete dialysis technique than conventional HD.

The mean duration of the HD (t) in Spain has always been low compared to other countries[36], although is increasing. In DOPPS I, t was 215 minutes, 220 minutes in DOPPS II and 228 minutes in DOPPS III. The duration of the session is a factor associated with improved survival even independently from Kt/V.[36,38] The mean duration of the HD in this study is 230 minutes and, although half of patients do not reach the 240 minutes mark, it is higher than that observed in DOPPS for Spain.

Biochemical parameters, some as albumin, in relation to mortality are worse in incident patients than in prevalent patients, possibly showing that even patients with advanced chronic kidney disease (ACKD) or predialysis come into dialysis precariously, without good medical control. We must take into account that rated analytical determinations are the average of six months, so that this difference between incident and prevalent is attenuated.

This study highlights the high percentage of patients receiving various types of drugs during its time period. This percentage increases from incident to prevalent patients for certain drugs, such as insulin, vitamin D, P binders and cinacalcet, and decreases with others, such as oral antidiabetics, antihypertensive drugs, including ACE inhibitors. With other drugs, such as statins and ESA it remains the same. One of the possible reasons for this observation may be, once again, EuCliD® methodology, which includes the use of encryption ATC (Anatomical Therapeutic Chemical Classification System), which would facilitate the evaluation of the medication used from the statistical point of view. While the use of classic oral antidiabetics is contraindicated in the case of HD patients, they are still used in a small percentage. Although in recent years concern for the diagnosis and treatment of bone mineral disease increased in patients with ACKD, it is performed more completely during the HD stage, as evidenced by the increased use of calcimimetics and vitamin D in prevalent patients in comparison with incident patients, as occurs with phosphate binders, higher in prevalent patients than in incident patients.

Hospitalisation rates for these patients are low: 0.46 hospitalisations per incident patient/year and 0.52 per prevalent patient/year, lower than the average for Spain (0.75) and Europe (0.99) in the Dopps study.[39] Mean hospital stay is similar to that of most studies.[39,40]

HD patient mortality in this study is considerably lower than GRER's.[25,26] According to the formulae used, it ranges from 10.8% in 2009 and 13.1% in 2010. GRER mortality was of 14.79% for 2009 and 17.3% for 2010. 2009 Mortality in GRER is in line with the figure for previous years, between 14% and 15%. On the other hand, given the fact that the population of this study is part of the registry's population and represents 20% of it, implies that the difference is even greater between patients studied here and the rest of patients, including hospital patients. These differences are maintained in the stratification by age group for both periods (Figure 2).

The formulae used to calculate mortality are the same ones used by records of different Spanish regions. Regarding the criteria used to define patients who died, this study was more demanding, and it counted patients deceased in other centres during the three months after their transfer. It attempts to avoid cases of patients transferred and who passed away soon after. One possible explanation for the discrepancy is in how GRER assesses deceased patients. Transplant patients in critical condition who lose kidney function, are transferred to HD and die shortly after are recorded as HD patients. The same can be applied to patients who are transferred from PD to HD for loss of peritoneal function, such as peritoneal sclerosis sufferers, who have very poor prognosis.

Mortality in other studies, such as ANSWER, is 13.8%, 13.8% also in the ARO study and 22% in DOPPS USA.[39]

The mortality of HD patients in this study is still very high. It has to be situated between the mortality of patients with leukaemia and myeloma,[41] which gives an idea of the magnitude of the problem. Another way to reference it is comparing it with the mortality rate in Spain in 2010, which was 0.79%, or that of people of 65 years old (0.90%), which means 13 times more mortality (INEbase, the National Statistics Institute).

The main cause of death in this study is CV death by 50% among incident patients and 55% among prevalent. Note that sudden deaths occurred in 19% of incident and 25% of prevalent patients. These percentages are similar to those of the ANSWER study[15] (23.5% sudden deaths), the 22% in the HEMO study[42] and the ARO study (42% of CV). In GRER[25,26] the percentages for sudden deaths are 4% in 2009 and 6% in 2010. Probably much of unknown origin causes correspond to sudden deaths, 14% and 15% respectively. We see great improvement on this type of death.

The percentages of deaths caused by infection in the GRER, 18% and 19%, are higher than those of this study (between 6% and 10%).

Interruption of treatment in this series is very low, both in incident and prevalent patients, as it is usual in Spain.

CONCLUSION

Patients treated in FME clinics seem to have comorbidity and epidemiological characteristics similar to those of GRER and other series of HD patients, including hospital HD patients. The result of morbidity and mortality in FME clinics can therefore be considered good as compared to the GRER and other international series. This does not mean that there are no areas for improvement, such as increasing the dialysis time, convective techniques and the percentage of native AVF.

Conflicts of interest

The authors are members of the ORD scientific group, promoted by Fresenius Medical Care in Spain.

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