Statistics Report 2001

Acknowledgements

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Introduction

The Renal Registry of Catalonia (*Registre de Malalts Renals de Catalunya*: RMRC) is a mandatory population registry that collects and collates information on all patients receiving renal replacement therapy (RRT) in Catalonia.

The RMRC, which is now assigned to the Health Care Area of the Catalan Health Service, was created in 1984 as a support tool within the Health and Social Security Department program dedicated to renal failure patients. The Commission for Control and Monitoring of the Registry was founded at the same time with the purpose of assuring the confidentiality and quality of the data and to optimize the Registry for the information requirements of health management in nephrology.

In 1988 the Registry was submitted to an external validity check. The results showed exhaustive recording of relevant variables and excellent concordance, thereby evidencing the validity of the data for use in clinical and epidemiological studies. These results can also be considered an indicator of the Registry's proper functioning.

In 1990, the RMRC became a local registry of the European Dialysis and Transplant Association (EDTA), in order to avoid duplication of data collection by the medical personnel. Since 1999 the Registry has cooperated with the Collaborative Transplant Study (CTS) by providing information on renal transplants performed in Catalonia.

Since the creation of the RMRC, a **Statistics Report** has been elaborated annually to present and disseminate the results of analysis of the data obtained. In keeping with the aims of the Registry, this document contains information on the scope of the problems related to treated end-stage renal disease (ESRD) in Catalonia and on the sociodemographic characteristics, morbidity and mortality of patients receiving RRT. Additionally, a part of the report is devoted to presenting the results from non-systematic sources, and information from specific studies and databases outside the Registry that contribute to increasing the knowledge about treated ESRD in Catalonia, from both the clinical and epidemiological standpoints.

This document is largely dedicated to presenting the data from 2001 and the trends manifested since 1984. This year the hemodialysis section contains information from the on-going study of vascular access routes started in 1996. The data collected over these six years is analyzed in relation to the characteristics of the patients, and a study has been carried out to determine mortality associated with the type of vascular access used in the initial dialysis. The section on morbidity provides an update of information

from the study on dyslipidemia and cardiovascular risk factors.

This year the specific study is, once again, related to renal osteodystrophy in dialysis patients.

Material and methods

Incidence and prevalence

The reference populations for the calculations of incidence and prevalence have used the 1991 Catalan census for the period 1992-1995, the 1996 census for the period 1996-2000 and the 2000 pattern for 2001. Incidence in this report is defined as the number of patients residing in Catalonia who initiated RRT during the year as referred to the total population of Catalonia. Incidence rates are expressed per million population and year. Prevalence is defined as the total number of RRT patients residing in Catalonia and alive on 31 December, also as referred to the general Catalan population. Prevalence rates are expressed per million population (pmp).

Some of the tables refer to the total of treated patients in Catalonia, both residents and non-residents; this fact is specified in each case.

Rates corresponding to each health region have been age- and gender-adjusted to render them comparable and to avoid a potential effect due to differences in population composition. Incidence rates were adjusted according to the indirect method of standardization to allow comparison between the rates in each health region (HR) and the overall rate in Catalonia. Prevalence rates were adjusted by the direct method of standardization to the Catalan adult population (over 14 years old). Since ESRD is less frequent in children, the standardized incidence and prevalence values are higher than the crude values used to compare the data from Catalonia with other communities or countries. The confidence interval (at a 95% confidence level) of the rates adjusted by the indirect method was calculated according to the following formula (LONG, 1977):

$$\text{Specific rate} \pm 1{,}96 * \frac{\text{Overall rate}}{\text{Theoretical cases}} * \sqrt{\text{Observed cases}}$$

The confidence interval (at a 95% confidence level) of the rates adjusted by the direct method was calculated according to the following formula (RUE, 1993):

$$\text{Specific rate} \pm 1{,}96 * \sqrt{\frac{\text{HR stratum-specific rate}}{\text{Catalan stratum population}} * \left(\frac{\text{HR stratum population}}{\text{Population of Catalonia}}\right)^2}$$

Statistical analyses were performed with the SPSSx program. The chi square (c^2) test was used to determine the independence of the qualitative variables, the Student's *t* test for comparison between means of two groups, and analysis of variance (ANOVA) for comparisons among means of more than two groups.

Survival

Overall survival and survival analyses by primary renal diagnosis group, by age group, by number of concomitant diseases at the start of RRT, and by functional autonomy grade were performed with all new patients included in the Registry from 1 January 1984 to 31 December 2001. These cases were recorded prospectively; thus the information on them is complete and detailed follow up data are available.

To avoid potential bias, patients who initiated treatment before creation of the Registry have been excluded from these analyses. The data for these patients were collected retrospectively and information is incomplete in some cases. Additionally, due to the difficulty in retrieving information on patients who had already died at the time that data were collected, the number of survivors in this group of patients may be over-represented, particularly those who never received a transplant.

Survival according to treatment has been calculated using each sequence of treatment as the unit of analysis, rather than by patient. All treatment periods falling within 1 January 1984 and 31 December 2001 have been included. For the purpose of statistical calculation, changes in treatment were considered lost to follow-up.

Survival in transplant recipients has been calculated for patients receiving transplants between 1 January 1984 and 31 December 2001. Patients receiving multiple transplants (kidney plus pancreas, kidney plus liver, and double kidney) have been excluded from the analysis, since their characteristics are different from those of the other recipients. Survival for patients and for grafts have been calculated by type of transplant (from a living donor or cadaver) and by immunocompatibility characteristics (according to HLA-DR, A or B matches, and according to recipient reactivity).

Survival tables for the univariate analyses were elaborated by actuarial methods and the level of statistical significance was evaluated among the different curves of a single analysis. Overall comparison and paired comparisons of the subgroups were done with the Gehan test (SPSS, 1983), using the SPSSx program.

A proportional risks model was applied in the multivariate analyses using the SPSS program (version 10.06) and incorporating Breslow's proposed modification for the Cox regression, in which coefficients are estimated by means of the Newton-Raphson iterative algorithm. Statistical significance of the estimated relative risks was determined with the maximum likelihood method and the chi-square test.

Treated end-stage renal disease in Catalonia

Overall incidence and prevalence data for treated ESRD in Catalonia and number of transplants in 2001 are presented in Table 1 in absolute numbers and rates per million population, together with the number of deaths and mortality expressed per 100 patients.

Table 1. Overall results of end-stage renal disease in Catalonia, 2001

The prevalence rate has continued to grow in recent years (Table 2). Despite slight fluctuations, the incidence rate is still one of the highest in Europe. This year the transplant rate has increased again in relation to the year before. At 62.7 transplants pmp, it is now the highest rate recorded since the initiation of this treatment. This figure is a measure of the activity calculated from the total number of transplants performed (regardless of the origin of the donor or recipient) with respect to the general population of Catalonia.

The mortality rate this year is almost the same as that of the last few years.

Table 2. Treated end-stage renal disease in Catalonia, 1996-2001

Description of the population receiving renal replacement therapy

Sociodemographic data

Figure 1 provides a summary of the changes in the mean age of patients starting RRT and in the survival of patients at the end of the year, over the period encompassing 1986-2001. The graph also shows the changes in the mean age of patients that died over this time. The age of the prevalent population is increasing at the same rate as in previous years, so that a relatively stable trend is being maintained. The annual mean ages of the incident population show greater variation, since there are fewer new cases than prevalent cases.

Figure 1. Mean age of patients receiving RRT, 1984-2001

In comparison to the year before, there is an increase in the overall and gender-specific mean ages of the incident population. These increases are less pronounced in the prevalent population, both in men and women.

With regard to the evolution in mean age of patients that died over the period depicted, the situation is similar to the trends in incidence: there are slight fluctuations due to the limited number of cases, but in general, RRT patients are dying at an increasingly more advanced age. In this last year, the overall mean decreased by almost one year; in the group of men the decrease was nearly two years and in the group of women there was an increase in age of around half a year.

There is a predominance of men among patients on RRT (61.4%), and the 60-80 year-old age groups in both sexes have the most cases (43.9%).

Figure 2. Age distribution of patients when starting RRT, expressed in number of cases and percent terms, 1984-2001

Figure 3. Distribution of treated ESRD incidence rates by age groups and gender, 2001

Figure 2 shows the distribution of new cases by age groups for the period of 1984 to 2001. In the groups less than 60 years old there is a gradual decrease in the percentage of incident patients over the yearly total, despite the fact that the number of patients in these groups starting RRT per year remains more or less stable. In contrast, in the groups over 60 years old there is a gradual increase, both in absolute numbers and percentages that is much more significant in the over-70 groups. According to these data, the high RRT incidence rates observed are maintained because of the inclusion of increasingly older patients. The distribution of patients by age group in 2001 is virtually the same as in the last few years.

Figure 4. Distribution of treated ESRD prevalence rates by age groups and gender, 2001

Figures 3 and 4 depict the incidence and prevalence rates of treated ESRD by age and sex. Rates increase with age, particularly after 40 years and up to 80 years. After this, they begin a decrease that is more pronounced in the group over 84 years old. Rates in men are always higher than in women, although distribution is similar.

Figure 5 shows the existing differences in family structure or living situation of patients starting RRT in 2001 according to gender. Among the total of RRT patients, the majority live with their spouses; nevertheless the percentage of men in this situation is higher. The living situation also shows some relation with the age of the patients. Most patients (78.9%) living in a residence or center for the elderly are over 64 years old. The percentage of patients living with a spouse is 53.4% in the group 15 to 44 years old, 71.0% in the group 45 to 64 years old, 65.7% in the group 65 to 74 years old and 42.7% in the group over 74 years old.

Distribution by educational level is summarized in Figure 6. Patients 15 to 44 years old have the highest level of education, with16.5% having finished secondary school and 11.2% having higher education degrees. These percentages decline with increasing age of the patients. Gender-specific differences can also be observed, since among the 5.5% of patients with higher education degrees among all the age groups, 80.0% are men. The same is true for the group with secondary school education (7.4% of patients), in which 70.1% are men.

Figure 5. Distribution by type of family structure or living situation according to gender. New cases 2001

Figure 6. Distribution by educational level according to age group. New cases 2001

Figure 7. Distribution by socioeconomic status (National Statistics Institute of Spain classification) according to gender. New cases 2001

Figure 7 shows the socioeconomic status of patients starting RRT during 2001: 65.2% of patients or heads of family have a stable job and receive salaries, 15.0% are self-employed without fixed salaries, 9.6% have part-time or temporary jobs, 6.0% work in family businesses, 3.1% are businessmen employing paid workers and 1.0% work in cooperatives. Among the total of patients, 18.6% are actively working (22.5% of men and 11.6% of women). Analysis of working-age patients shows that 64.6% are actively working in the 15 to 44 year-old group, whereas only 33.1% are actively working in the 45 to 64 year-old group.

Presentation of irreversible renal failure

Since 1993 the Registry has gathered information on patients starting RRT to determine whether initiation of this treatment was required because of acute presentation of the disease, because of aggravation of known disease or because of normal evolution of the disease process.

The distribution of this variable for 1993 to 2001 is presented in Figure 8. Some fluctuations can be seen, but they are minimal. There is, however, a considerable decrease in the percentage of cases for which this information is missing; these cases accounted for 12.6% of the total in 1993 and only 1.4% of the total in 2001.

Analysis of presentation by age group demonstrates that the percentage of patients with normal evolution to end-stage renal disease decreases with increasing age (Figure 9).

Figure 8. Distribution by type of presentation of end-stage renal disease. New cases, 1993-2001

Figure 9. Distribution by type of presentation of end-stage renal disease according to age group. New cases, 1997-2001

There are also important differences in presentation of ESRD ($p<0.00001$) with regard to the diagnosis of primary renal disease. In patients with polycystic kidney disease, presentation of ESRD is a consequence of normal evolution of the disease in 81.7% of cases, whereas in patients with nephropathy due to vascular causes and in the group of "other diseases", this proportion is 56.9% and 46.3%, respectively (Figure 10).

Figure 10. Distribution by type of presentation of ESRD according to primary renal disease. New cases, 1997-2001

Primary renal disease

Regarding incidence, there is a slight increase in diabetic and vascular renal disease as compared to the previous year. Diabetic nephropathy is the main cause of ESRD (20.6%), followed by vascular nephropathy (18.8%) and nephropathy of unknown origin (17.6%). The remaining diseases have remained stable (Table 3 and Figure 11). Prevalence, in contrast, is substantially unchanged in recent years, with a predominance of patients with glomerular disease.

Table 3. Incidence and prevalence according to primary renal disease, 2001

The distribution of primary renal disease shows significant differences ($p<0.0001$) between the age groups. Diseases of unknown origin are frequent in the older groups (24.6% in those over 74 years old), mainly because it is difficult to precisely determine the etiology of renal failure in patients with deteriorated health status due to age, and because biopsy may mean an added risk or low therapeutic yield in some patients. Glomerular disease predominates in the 15 to 44 year-old group (28.3%) and polycystic kidney disease increases after 44 years. In around 50% of childhood cases, primary renal disease (PRD) is included in the category of *other diseases*, which encompass medullary cystic disease, cystinosis, "prune belly" syndrome and particularly, renal hypoplasia.

Figure 11. Incidence and prevalence according to primary renal disease, 2001

Figure 12. Diagnostic tests according to primary renal disease. New cases, 2001.

Figure 13. Mean time between first visit with the nephrologist and start of RRT, 2000-2001

Since the year 2000 the Registry has gathered information on the mode in which PRD was diagnosed: biopsy, pathognomonic diagnostic tests or clinical suspicion. In 2001, 72.1% of glomerular disease, 50.8% of nephropathy in the group "other diseases" and 12.7% of renal vascular disease were diagnosed by biopsy. In the remaining diagnoses,

the figure was below 10%. Pathognomonic tests provided the diagnosis of 88.7% of polycystic kidney disease, 45.3% of renal disease of interstitial etiology and around 25% of renal diseases in the groups diabetic, vascular, and others (Figure 12).

Systematic recording of the year of first visit to the nephrologist also began in the year 2000. Figure 13 shows the mean interval of time between the year of first visit to the nephrologist and initiation of RRT. Patients with polycystic, glomerular, or interstitial renal disease have been under treatment by the nephrologist for the longest time, whereas diabetic patients and those grouped under other nephropathies have been under treatment for the shortest time.

The mean treatment period prior to the start of RRT was 4.22 years in 2000 and 5.52 years in 2001. Although this increase seems to be an indication that patients are attended by nephrologists at an earlier stage of irreversible renal failure, more time is required to determine whether this trend becomes consolidated.

Type of treatment

Figure 14 depicts the distribution of patients by type of treatment on 31 December 2001. A percent decrease in patients treated with assisted hemodialysis (AHD) and an increase in patients with a functioning cadaveric renal transplant (CRT) (0.8%) is evidenced, whereas the percentages of other therapeutic techniques remain very low. The percentage of patients with functioning living-donor renal transplants (LDRT) remains stable (1.5%) and the number of patients on continuous cyclical peritoneal dialysis (CCPD) is now greater than that of patients on continuous ambulatory peritoneal dialysis (CAPD).

Figure 14. Prevalence by type of treatment, 2001

Figure 15. Prevalence by type of treatment, 1986-2001

Among the younger group (less than 45 years old), 64.3% of patients have a functioning transplant. This proportion decreases to 30.1% in patients 65 to 74 years old. The rate of peritoneal dialysis use is similar in all the age groups (around 3%), though CCPD is more extensively used in the younger groups and CAPD in the older groups.

Upon analysis of distribution by type of treatment and age in the period 1986-2001 it is observed that 38.1% of patients in the **0 to 44 year-old age group** had a functioning transplant and 61.9% were in dialysis in 1986. These proportions inverted after 1987 and more patients had functioning transplants than were in dialysis. In 2001, 66.2% of patients have a functioning transplant and 33.8% are in dialysis.

Among the **45 to 64 year-old group**, the percentage of patients with functioning transplants in 1986 was 17.4%. In 1995 the proportion of patients with functioning transplants was similar to that of patients in dialysis and in 2001 patients with functioning transplants increased to 57.5%. Regarding the **group of patients over 64 years old**, the percentage of patients with a functioning transplant in 1986 was practically null, whereas in 2001 22.0% of patients in this group have functioning kidney grafts (Figure 15).

Table 4 shows the distribution of types of treatment by health region. Prevalence data are expressed in absolute numbers and in percent terms, whereas incidence and mortality data are presented only in absolute numbers.

Figure 16 is a flowchart showing the movement of patients among the various treatment modalities during 2001 and the situation on 31 December.

Table 4. Distribution of types of treatment by health region of residence, 2001

Figure 16. Patient flow of residents in Catalonia in renal replacement therapy, 2001

Dialysis

The percentage of patients receiving dialysis treatment in their health region of residence (87.1%) is virtually the same this year as in previous years. The remaining 12.9% has to travel to other health regions to receive dialysis. This group is mainly comprised of patients from the *Barcelonès Nord y Maresme*, *Costa de Ponent* and *Centre* health regions, who use the nephrological care resources of the city of Barcelona for dialysis because of geographical proximity. The largest number of patients residing outside of Catalonia and receiving dialysis treatment is attended in the *Lleida* health region. These cases mainly come from Aragonese towns in the *Franja de Ponent* (Table 5).

Table 4. Distribution of dialysis patients by health region of residence and health region of treatment, 2001

Hemodialysis

As in former years, an analysis has been performed of all patients initiating HD by year, including those who initiate HD as the first technique for RRT, those who have been treated previously with other techniques (transplant or peritoneal dialysis) and those coming from other autonomous communities and who receive dialysis in Catalonia. Figure 17 shows the channels by which patients initiate hemodialysis (left columns) and discontinue hemodialysis (right columns).

The total number of patients initiating HD in 2001 (1021 cases) represents a slight elevation over the previous year. There are 982 discontinuations of the technique for various reasons, resulting in a net increase of 39 persons. Given the general increase in the number of new patients, the last four years have witnessed an increase in patients initiating HD and using it as the first technique for RRT. Now this trend, as well as the number of patients initiating HD because of graft failure or discontinuation of peritoneal dialysis, appears to have stabilized. Regarding discontinuations of HD, the number of deaths in this technique has increased considerably, (500 deaths in 1996, 600 in 2000 and 615 in 2001). This fact, together with the continuing high rate of transplants, is the reason why the number of patients leaving this technique has also continued to grow in the last years.

Figure 17. Patients initiating and discontinuing hemodialysis, 1991-2001

Table 6 details the number of patients initiating assisted HD in each of the health regions of residence 1999-2001.

Table 6. Patients initiating hemodialysis by health region of residence, 1999-2001.

Figure 18. Cause of the change from hemodialysis to peritoneal dialysis, 1993-2001

Figure 19. Weekly hours of hemodialysis, 1990-2001

Information on the causes prompting a change from hemodialysis to peritoneal dialysis has been collected since 1993 (Figure 18). Lack of a vascular access is the main reason why patients discontinue HD and pass to PD (35.1%), followed by the patient's own decision in this respect (27.8%). The small number of cases involved (194) and the high percentage of cases lacking information (25.3%) impedes the performance of more detailed analyses to investigate the influence of other factors on this change of dialysis modality, such as primary renal disease, age, and time that the patient has been on dialysis.

Regarding the periodicity of treatment, this year has witnessed a new decrease in the percentage of patients receiving dialysis for less than 10 hours per week. Figure 19 illustrates this trend. Although the great majority of patients are dialyzed during 10 to 12 hours weekly, this proportion was seen to fall in favor of those treated for 9 hours weekly, with proportions of 16% in 1990, 31% in 1996 and 28.0% in 1997. This year the rate is 11.4%. The percentage of patients dialyzed for 9 hours weekly varies according to patient sex (7.2% of men and 18.0% of women) and age (6.6% of patients 15 to 44 years old, 7.7% of those 45 to 64, 11.4% of those 65 to 74 and 16.9% of those over 74), and according to the level of nephrological care of the dialysis center (6.4% of patients dialyzed in nephrology services, 19.0% of those in nephrology units and 9.3% of those in dialysis centers). The percentages of patients dialyzed less than 9 hours or more than 12 hours is maintained at around 6%. Some 98% of patients attend three hemodialysis sessions per week.

Figure 20 shows the distribution of dialysis patients according to number of hours of dialysis per week and body surface area. Among the patients dialyzed for 9 hours or less, 77.5% have a body surface area of less than 1.7 m^2, whereas in patients dialyzed for more than 12 hours per week, only 37.1% have this same body surface area. Only 2 patients dialyzed for less than 9 hours weekly have body surface areas over 1.7 m^2. The graph shows that the mean body surface area increases significantly as the number of hours under dialysis increases ($p<0.00001$): patients dialyzed for less than 9 hours have a mean body surface area of 1.59 m^2, those dialyzed for 9 hours have a mean body surface area of 1.57 m^2, those dialyzed for 10 to 12 hours have a mean body surface area of 1.68 m^2 and those dialyzed for more than 12 hours have a mean body surface area of 1.73 m^2.

Figure 20. Percent distribution of patients in hemodialysis, by number of hours of dialysis weekly and body surface area, 2001

Vascular access

This is the sixth consecutive year in which data have been collected on the vascular access for hemodialysis. In the Statistics Report for 1996 there is a chapter dedicated to this subject. In the Report for 1997, in addition to a general description of the distribution of the various types of vascular accesses, there is a study on the characteristics of patients who have undergone four or more vascular accesses. In that same year a study was initiated to determine morbidity and mortality associated with the type of vascular access used in the first dialysis. In the Report for 1998 a study was carried out to investigate the risk factors associated with HD initiation using a catheter, and in 1999 another study was performed on mortality associated with HD initiation using a catheter.

Among the 3324 patients on hemodialysis alive and residing in Catalonia on 31 December 2001, information on dialysis access has been collected for 3317 patients (99.8%). Among this total, 2738 (82.5%) are dialyzed with use of an internal arteriovenous fistula (IAVF), 246 (7.4%) are dialyzed with various types of grafts and 333 (10.1%) are dialyzed with temporary or permanent catheters.

The IAVF is the preferred vascular access (82.5%) once again, despite a 2% decrease in its use as compared to last year. IAVFs are predominantly located near the wrist (61.5%) and secondarily near the elbow (38.5%); the left upper extremity is preferentially used for both these sites.

Heterologous grafts are the type most often used, with the saphena being implanted in only 5.7% of these patients. Around half of the grafts are placed in the lower extremities.

Figure 21. Distribution of the type of vascular access by primary renal disease, 2001.

Catheters are used in 10.1% of patients. There is a predominance of placement in the scapular region (94.0%) over the pelvic region (6.0%). The majority of temporary catheters are placed in the right side, and are distributed in the following manner: 12.9% in the subclavian vein, 38.4% in the jugular vein, and 6.0% in the femoral vein. Finally, 42.6% of patients are dialyzed using a tunneled catheter (*permcath*).

Figure 22. Distribution of the type of vascular access by age group, 2001

Figure 23. Distribution of the number of hospitalizations due to vascular access complications by type of vascular access, 2001

Figure 21 shows that patients with diabetic and interstitial nephropathies as well as those with *unknown* and *other* etiologies have higher percentages of catheters (12.6%, 11.5%, 10.8% and 14.2% respectively), whereas those with glomerular disease or polycystic renal disease have the lowest (5.7% and 6.4%, respectively).

Differences are also seen in the distribution of vascular accesses according to patient age. The older the age group, the higher the percentage of patients with catheters and grafts (Figure 22).

The number of hospital admissions due to complications associated with the vascular access was studied in patients alive on 31 December 2001. Among patients with a catheter, 55.9% did not require hospitalization this year, 21% were hospitalized once, 13.5% were hospitalized twice and 9.6% were hospitalized more than twice. In the case of patients with IAVFs the proportions were 90.1%, 7.6%, 1.5% and 0.8%, respectively (Figure 23).

Peritoneal dialysis

Figure 24 depicts the data on patients starting and discontinuing peritoneal dialysis. The progressive increase of patients initiating PD since 1992 is interrupted in 1995, recovers momentarily during 1998 and recovers once again this year, thanks to those initiating PD as the first RRT technique. This year 75 patients started PD as the first technique, almost as many as in 1998 (79 patients). The number and distribution of patients starting and discontinuing PD is similar to previous years. This year 39 more patients have

started the technique than have discontinued it.

Figure 24. Patients starting and discontinuing peritoneal dialysis, 1991-2001

Figure 25. Cause of the change from peritoneal dialysis to hemodialysis, 1993-2001.

Figure 26. Probability of developing peritonitis according to PD technique. New peritoneal dialysis cases, 2000-2001

Figure 25 shows the distribution of the causes prompting a change from peritoneal dialysis to hemodialysis during the period of 1993-2001. Peritoneal infection, and associated disease or severe complications are the main reasons for the change of dialysis technique, involving 29.0% and 28.6% of patients, respectively. These proportions increase to more than 40% when only the cases in which this information is recorded are included in the analysis.

The probability of developing peritonitis according to the technique used, chronic cycling peritoneal dialysis or chronic ambulatory peritoneal dialysis, was studied among the patients starting PD during the years 2000 and 2001. As seen in Figure 26, the cumulative one-year probability for developing peritonitis is 26% in a person receiving CCPD treatment and 41% in a person receiving CAPD treatment. These proportions change to 39% and 46%, respectively, at one year and a half.

In the 1996 report there is a more detailed analysis of peritoneal dialysis in our setting, including information on the different types of peritoneal dialysis, the connections and catheters used, a study of peritonitis episodes, etc.

Treatment with recombinant human erythropoietin

The 1996 report also contains a study on the use of recombinant human erythropoietin (r-HuEPO) in RRT patients, performed in conjunction with the Advisory Committee Registry on the therapeutic use of r-HuEPO. This section presents only the update of the results according to some variables from the Registry, such as patient age, gender, primary renal disease, and the health region of residence.

Figure 27. Distribution by age and gender of dialysis patients receiving r-HuEPO therapy, 2001

As in all the other years, the percentage of patients treated with r-HuEPO continues to grow. This year it is 91.1%, a figure slightly higher than last year. The proportion of women receiving r-HuEPO therapy is always higher than that of men for all the age groups. In the group of patients less than 15 years old, there are very few cases and therefore, the percentages may show large variations. Both in men and women, the percentages within the various age groups have remained stable (Figure 27). The proportion of patients treated with this hormone varies according to the primary renal disease. A constant increase in the use of r-HuEPO is observed over the 1990 to 2001 period. In this last year, the rates range from 78.6% in patients with polycystic renal disease to more than 90% in all the other nephropathies (Figure 28).

Figure 28. Percentages of dialysis patients receiving r-HuEPO treatment by primary renal disease, 1990-2001

Figure 29. Percent distribution of dialysis patients receiving r-HuEPO therapy by health region of residence, 2001

Some differences are seen in the proportions of dialysis patients receiving r-HuEPO therapy according to the health region of residence, though each year these differences are smaller. This year the *Tortosa* health region (88.0%) has come much closer to the other regions: *Barcelona Ciutat* (89.7%), *Centre* (90%), *Tarragona* (90.7%), *Girona* (91.7%), *Lleida* (92.2%), *Costa de Ponent* (92.6%) and *Barcelonès Nord i Maresme* (94.5%) (Figure 29).

Transplants

This year 396 kidney transplantations were performed in Catalonia, a considerable increase since last year; 2001 has been the year of greatest activity in renal transplantation. This figure represents a transplant rate of 63.2 pmp, and is higher than the majority of European countries with extensive transplant activity.

Figure 30 shows the overall transplant activity according to the type of transplant since 1984. This year the number of living-donor renal transplants has continued to increase; 13 such transplants were performed, 5 more than last year. The number of combined kidney-pancreas transplants has remained quite stable. The first combined kidney-liver transplant was performed in 1988, and since then there have been 51 such procedures. In 1997 the first double kidney transplant (dual RT) was performed. This new modality attempts to take better advantage of the resources, considering as valid certain kidneys that would not have been accepted as single transplants. Eight such procedures were carried out this year, the same number as in 2000. This year witnessed the second combined heart-kidney transplantation; the first was performed in 1999.

Figure 30. Number of transplantations, 1984-2001

Recipient data

As was seen in the graphs showing RRT distribution by age and gender, the population receiving RRT treatment is aging. This fact is also reflected in the continuous increase in the mean age of patients receiving transplants. These trends are depicted in Figure 31, together with the percent distribution by age group of patients over 55 years old transplanted during the period of 1990 to 2001. The mean age of patients at the time of transplantation ranges from 34.1 years in 1985 to 49.0 years in 2000; mean age in 2001 was 47.7 years.

Starting in 1990 the percentage of transplantations performed in the 55 to 59 year-old group has remained stable. Nevertheless the percentage of transplantations has increased in the over 60 year-old group since 1988 and in the over 64-year-old group since 1990, although these groups show more irregular trends.

The increase in the number of transplantations in diabetic patients also stands out, being 3.8% of the total in the period of 1984 to1989 and 9.1% in the period of 1995-2001. It should be mentioned that this increase also implies a qualitative change, since presently the majority of these are simultaneous kidney-pancreas transplants. In 2001, 22 such transplants were performed.

Figure 31. Percentage of kidney transplants in patients over 55 years old and mean age of patients receiving a transplant, 1990-2001

Table 7. Comparative data for renal transplantation in Catalonia within the periods 1984-1989, 1990-1994 and 1995-2001

Table 7 summarizes the transplant data for the various factors studied according to a division into three time periods, 1984 to 1989, 1990 to 1994, and 1995 to 2001. Differences among these periods are always very significant, except for the data on retransplantation, which shows similar percentages for the three periods. To summarize the present situation in Catalonia, transplantations are now being performed in older patients, in a higher percentage of diabetic nephropathies (mainly kidney-pancreas transplants) and there is a slight tendency toward an increased proportion of retransplantations. The trend regarding mean HLA-DR matches is not clear.

Table 8 depicts the distribution of patients with a functioning transplant by health region of residence and health region of treatment, both for transplants performed this year and for the total of patients with a functioning transplant monitored in Catalonia.

Table 8. Distribution of patients receiving a transplant by health region of residence and health region of treatment, 2001

The percentage de patients from outside of Catalonia who received a renal transplant this year was 10.9% (43 patients). In the first years these proportion
ranged from 20% to 25%; in 1995 it was 17.1%. This tendency can be explained by the increase in transplants carried out in other autonomous communities during the last years. This year most of the patients from outside of Catalonia receiving transplants in Catalan renal transplant units were from the Balearic Islands (15 patients), the Autonomic Community of Valencia (10 patients) and from Castilla-La Mancha (4 patients).

Despite the continuous increase in patients on RRT, the number on transplant waiting lists has not increased proportionately. The number of patients on waiting lists is quite stable, though the proportion of the total shows a slight decrease. Nevertheless, there has been an increase in the number of patients pending study (Figure 32). Another datum to highlight is the spectacular increase in the number of patients excluded from the waiting list for clinical reasons, starting in 1990: in 1989 222 were excluded from the waiting list (6.3% of the total) for this reason and in 2001, 1003 (15.8%) were excluded. This may be a consequence of changes in the criteria used to report this datum, since at that time the age limit for transplantation was extended.

The percentage of patients on the waiting list (excluding those pending clinical or histocompatibility study and those with a functioning transplant) decreases with age, passing from 83% of patients 15 to 44 years old, to 1.3% of patients over 74. Among patients 45 to 64 years old, 30% are excluded from transplantation for clinical reasons. Large differences in the situation of the waiting list are observed according to the primary renal disease: 59.8% of glomerular patients on dialysis are on the waiting list (or pending study) to receive a transplant, whereas only 30.6% of diabetic patients and 20.6% of vascular patients are in this situation. Moreover the diabetic patient group has the highest percentage of cases excluded due to clinical reasons (47.9%).

Figure 32. Situation of RRT patients residing in Catalonia with regard to transplantation, 1990-2001

Figure 33 shows the situation of the transplant waiting list for patients initiating RRT during the period 1990-2001, and who were not initially excluded from the list for any reason (age, clinical reasons, voluntary exclusion). At the end of the first year, 3.3% of patients had received a transplant, 18.2% had performed all the studies and were on the list, and the 60.4% remaining were pending study. At 5 years, 39.9% had functioning transplants, 14.6% were on the waiting list, 5.1% were pending study, 15.6% were excluded and 24.7% had died. At 10 years, 41.0% continued with a functioning transplant, 4.7% were on the waiting list, 3.4% were pending study, 8.5% were excluded and the remaining 42.2% had died.

Figure 33. Situation of the waiting list and mortality. New RRT cases from 1990 to 2001 who were not initially excluded from the list

Figure 34. Previous time interval on dialysis of patients receiving a first cadaveric kidney transplant. Transplantations 1986-2001

Figure 34 shows the previous time on dialysis of patients residing in Catalonia who received a first cadaveric renal transplant (CRT) during the period 1986-2001, expressed in annual means with the respective 95% confidence intervals. The overall mean interval on dialysis is 38.6 months and the interval for 2001 is 29.7 months. Although there are fluctuations, a clear tendency to decreases in the time on dialysis while waiting for a transplant is observed.

Figure 35 depicts the mean months on dialysis of patients alive on 31 December 2001 and on the waiting list for a first transplant (including patients with clinical or histocompatibility studies pending), analyzed by health region of residence. The overall mean of Catalonia is 43.2 months and the health region with the shortest mean previous time on dialysis (36.4 months) *is Barcelonès Nord i Maresme*.

Figure 35. Time on dialysis of patients on the waiting list (31 December 2001) to receive a first cadaveric kidney transplant, by health region of residence

Figures 36, 37 and 38 summarize the probability of receiving a transplant as related to time on RRT and to other factors. Figure 36 shows that for the total of patients, cumulative probability in the second year is 34.1%, in the fourth year 57.1%, and in the sixth year 68.2%. In the next figure the same study is presented by age; the probability of receiving a transplant is lower in the patient groups with more advanced age. For patients under 15 years old, the cumulative probability of receiving a transplant is 52.6% in the first year, 78.6% in the second, 88.5% in the third, and100% in the sixth. For the group 15 to 44 years old, cumulative probability is 50.2% in the second year, 74.6% in the fourth year and 86.1% in the sixth year. In the 45 to 64 year-old group cumulative probability is 30.1% in the second year, 53.8% in the fourth year and 64.7% in the sixth year. Finally, for the 64 to 74 year-old group cumulative probability is 14.6% in the second year, 26.0% in the fourth year and 28.6% in the sixth year (Figure 37).

Figure 38 shows the same study according to primary renal disease. Patients with diabetic nephropathy have the lowest probability of receiving a transplant, followed by those with vascular nephropathy and those with an unknown etiology.

Figure 36. Cumulative probability of receiving a first transplant. Patients on the waiting list at initiation of RRT, 1990-2001

Figure 37. Cumulative probability of receiving a first transplant by age group. Patients on the waiting list at start of RRT, 1990-2001

Figure 38. Cumulative probability of receiving a first transplant according to the PRD. Patients on the waiting list at start of RRT, 1990-2001

Figure 39. Previous time on dialysis of patients who received a renal retransplant from a cadaveric donor, 1986-2001

In contrast to the decreases seen over the years in the time on dialysis before the first transplant, there are no clear tendencies in the time on dialysis before retransplantation. Patients who received a cadaveric retransplant during 1986 to 2001 were a mean of 40.3 months on dialysis after the first graft failed. Those receiving a retransplant in 2001 were a mean of 49.3 months on dialysis after graft failure. The annual number of retransplants is smaller and therefore the 95% confidence intervals are wider (Figure 39).

The study of annual transplant data (Figure 40) shows the previous treatment techniques used and the number of transplant patients that start or return to other techniques over time. The characteristics of the patients receiving a transplant have already been discussed, but it is worthwhile to highlight the existence of a small number of patients (7 this year) who received a transplant without having undergone any other renal replacement therapy, and the increase in patients previously treated with peritoneal dialysis. In 1996 and 1997 the number of patients residing outside of Catalonia and receiving a transplant in Catalan dialysis centers decreased, in 1998 it increased slightly, and thereafter it decreased once again. This year the proportion of these patients was 10.1%.

Figure 40. Annual patient flow: transplantations, 1991-2001

The study on immunosuppressive treatments has been carried out with data collected since 1990. The last three years have seen an increase in the use of new immunosuppressive drugs, such as mycophenolate and tacrolimus, and a significant decrease in the use of cyclosporine-A and azathioprine. The distribution of immunosuppressive drugs used in the first six weeks after transplantation is shown in Figure 41, which compares drugs applied in 1995 and those applied in 2001. Because of the changes that have come about in protocols for immunosuppressive therapy, in 2000 a new category was included: anti-CD25 (humanized and chimerized). This year there has been a significant decrease in the use of cyclosporine A, azathioprine, GAL and OKT3 and an increase in the use of mycophenolate, tacrolimus and anti-CD25.

Figure 42 indicates the types of drugs used for maintenance immunosuppressive therapy in patients with functioning transplants on 31 December 2001. There is a substantial difference in the types of drugs used for immunosuppression in 1995 as compared to 2001. Even though their application has decreased, corticoids and cyclosporine are still the most extensively used drugs for this purpose. Mycofenolate and tacrolimus are gaining ground, but are still not on a par with these agents.

Figure 41. Immunosuppressor drugs used during the first six weeks after transplantation, 1995 and 2001

Figure 42. Maintenance immunosuppressor therapy for functioning transplants on 31 December 2001

As was done in previous years the Cockroft-Gault formula, which includes serum creatinine value, age, weight and sex, was used to estimate creatinine clearance in transplant recipients. This useful test has been accepted as an indirect indicator of glomerular filtration.

Cockroft-Gault formula:

$$\text{Estimated creatinine clearance rate in men} = \frac{(140 - \text{age}) \times \text{kg body weight}}{\text{Serum creatinine mg/dL} \times 72}$$

$$\text{Estimated creatinine clearance rate in women} = \frac{(140 - \text{age}) \times \text{kg body weight}}{\text{Serum creatinine mg/dL} \times 85}$$

Figure 43 shows estimated creatinine clearance by sex in patients with functioning grafts on 31 December 2001, as calculated with the Cockroft-Gault formula. Men generally have better glomerular filtration rates than women do. As can be seen, only 9.1% of men have deficient filtration levels (below 30mL/min) as compared to 16.2% of women.

Figure 43. Estimated serum creatinine clearance by gender. Patients with a functioning graft on 31 December 2001

Glomerular filtration has also been analyzed according to recipient and donor age, as shown in Figures 44 and 45. The data presented correspond to the third-year update on 31 December. As can be seen in both figures, the greater the age of both recipients and donors, the poorer are the glomerular filtration rates and the higher are the percentages of patients that die. Also in both figures, the percentage of patients that go back to dialysis is not very large.

Figure 44. Estimated creatinine clearance by recipient age. Update in the third year after transplantation. Transplants 1990-1998.

Figure 45. Estimated creatinine clearance by donor age. Update in the third year after transplantation. Transplants 1990-1998

Figure 46. Percentage of graft failures and patient deaths in the first year after transplantation. Transplants, 1984-2000

The causes of renal graft loss in the first year after transplantation can be divided into two groups: those due to graft failure and those due to death of the patient (whether or not the graft is functioning). Figure 46 shows that graft loss due to both these causes has decreased in recent years. In 1984 there were more than 17% of graft failures and more than 7% of deaths in the first year. Since 1998 there has been an important decrease in graft losses in the first year after transplantation, which can be attributed to the incorporation of new drugs. In 2000, these percentages were 5% and 2.7%, respectively.

The main causes of graft loss have been analyzed in relation to the time interval since transplantation and to the date of transplantation. For this purpose, two groups were distinguished according to the time graft failure occurred, that is, graft failure in the first

year after transplantation and graft failure in later years. Additionally, two periods were established according to whether transplantation was performed from 1990 to 1997, or later. The overall incidence of graft loss during the first year post-transplantation is 16.5% person-years for the period 1990-1997 and 9.5% person-years for the period 1998-2000. The incidence of graft loss after the first year post-transplantation is 5.6% person-years during the first period and 3.3% person-years during the second period.

The main causes of graft loss during the first year after transplantation in both time periods are death of the patient, complications and acute rejection. Percentages in the second period are always smaller than those in the first period (Figure 47). The most frequent causes of graft loss after the first year post-transplantation are chronic rejection and death of the patient (Figure 48). Transplant recipients from the first period show a higher incidence of graft loss in all the causal categories.

Figure 47. Distribution of the causes of graft loss during the first year after transplantation by period. Periods 1990-1997 and 1998-2000

Figure 48. Distribution of the causes of graft loss after the first post-transplantation year by period. Periods 1990-1997 and 1998-2000

Donor data

In 1995 data on the donor, such as age, sex and cause of death, were retrospectively collected up to 1990. The inclusion of this new information has improved the analyses presented regarding cadaveric transplants.

Figure 49. Distribution of cadaveric kidney transplants from donors over 50 years old and distribution of mean donor age, 1990-2001

Figure 50. Distribution of cadaveric kidney transplants by cause of donor death. Transplants 1990-2001

In Figure 49 it can be seen that donor age is clearly increasing. In 1990 20% of kidney grafts came from donors over 50 years old, whereas is 2001 the figure passes to 42.1%, slightly lower than the previous year. In this last year the proportion of kidneys from donors 70 years old or more was 9.5%, whereas in the period 1990-1994 the figure ranged from 1% to 2%. As a consequence, mean donor age has passed from 31.4 years in 1990 to 44.7 years in 2001. There has been a decrease of one year as compared to the mean in 2000.

In the last years there have been some changes in donor typology. As has been mentioned, donors are increasingly older; analysis of the causes of death shows a decrease of donors due to cranioencephalic trauma (CET) and an increase of donors due to cerebrovascular accidents (CVA) (Figure 50).

In order to match donor and recipient age, the age groups have been recalculated. **Young recipients** are now considered to be those under 60 years old and **old recipients** are those 60 or over. Likewise, **young donors** are considered to be those under 60 years old and **old donors** are those 60 or over.

The next figure presents an analysis of estimated creatinine clearance calculated with the Cockroft-Gault formula in patients receiving a cadaveric renal transplant, according

to donor and recipient age. Serum creatinine values used in the analysis correspond to results from determinations carried out on 31 December the third year after transplantation. Included within the estimated clearance levels is the category *non-functioning kidney* (dialysis) and *death of the patient*.

In the third follow up, young recipients with renal transplants from young donors had better glomerular filtration, with normal rates in 35.4% of cases.

Figure 51. Estimated creatinine clearance in recipients of a cadaveric kidney according to donor and recipient age, in the third follow-up, 1990-1998.

In contrast, young recipients of a kidney from an old donor have poor estimated creatinine clearance (>59mL/min., 13.3%) and higher mortality than young patients receiving kidneys from young donors (7.6% as compared to 3.4%). Although 14.6% of old recipients receiving a transplant from a young donor have good glomerular filtration rates, mortality in this group is higher at 14.6%, than the rate in old recipients receiving a transplant form an old donor, at only 13.1% (Figure 51).

Figure 52. Cold ischemia time of kidney grafts. Transplants 1990-2001

Figure 53. Days on HD after transplantation in patients with acute tubular necrosis. Transplants 1990-2001

For proper analysis of these data, they should be studied together with the patient and graft survival curves according to the donor characteristics.

The following figures analyze several aspects of kidney transplantation. Figure 52 shows the changes in cold ischemia time of the organs used for transplantation in the period 1990-2001. There is a trend toward decreases in this time interval; in 1991 the mean number of hours in ischemia was 23.2, whereas this year it was 17.0. The number of days on dialysis post-transplantation in patients presenting with acute tubular necrosis has also decreased; the mean for 1991 was 4.2 days and the mean for 2001 was 1.1 days (Figure 53). Figure 54 depicts the percentage of patients with acute tubular necrosis; a decrease in episodes of this type is not so clear. It must be taken into account that the number of cases with incomplete information on this factor is very high (23.7%).

Morbidity

Concomitant disease

Morbidity in patients alive at the end of the year was analyzed according to several parameters, such as primary renal disease, age, and last type of treatment. In the first case, a classification system often used in the EDTA was applied: **standard disease** (codes 00 to 66), **diabetes** (codes 80 and 81) and **others** (codes 82 to 99). Since last year fifteen concomitant diseases have been included in the analysis instead of thirteen, with the addition of arterial hypertension (AHT) and irreversible visual deficit. In Figure 55 one can see that diabetic patients have the largest number of cardiovascular diseases (ischemic heart disease, cardiomyopathy, conduction alterations, cerebrovascular disease and vascular disease), whereas distribution of the remaining concomitant diseases studied is more homogeneous. The mean number of concomitant diseases is

similar to that of last year in all groups.

Figure 55. Concomitant diseases according to primary renal disease. Cases on 31 December 2001

With regard to age, the highest percentage of concomitant diseases is found in the groups of elderly patients. Concomitant cardiovascular or chronic respiratory disease is present in 22% to 40% of patients 64 to 74 years old and 30% to 47% of patients over 74 years old. Arthropathy is present in 46% of patients 64 to 74 years old and 65% of those over 74 years old. The percentage of concomitant diseases in the 45 to 64 year-old group ranged from 7% to 25%. Finally, in patients 15 to 44 years old, the proportion with concomitant diseases is around 5%, except in the case of heart disease, vascular disease, esophageal disease, diseases of the stomach and duodenum and arthropathy, which are situated at 10% to 15%. The proportion of tuberculosis and diabetes is below 9% in the three age groups. Chronic liver disease affects 5% to 20% of patients in the various age groups. Moreover, 67% to 77% of patients, depending on age group, have high blood pressure. (Figure 56).

Figure 56. Concomitant diseases by age group. Cases on 31 December 2001

Figure 57. Concomitant diseases by last treatment. Patients 45 to 64 years old with standard PRD and either on the waiting list or with a functioning RT. Cases on 31 December 2001

Since the populations in each of the treatment groups are different in parameters such as age and primary renal disease, which, as has been seen, are variables that affect the morbidity of the patients, the study was repeated after adjusting the populations for these factors to make them more homogeneous. Thus, for each of the two treatment groups we selected patients over 44 years old and under 65 years old with standard PRD, and in the case of dialysis patients, those who were on the RT waiting list. Results are presented in Figure 57. The mean ages of these new groups are 54.16 years for the dialysis patients (352 cases) and 55.11 years for the patients with a functioning transplant (1,121 cases). The mean values for concomitant diseases are in general terms equal, though dialysis patients still have a somewhat higher mean and higher percentages for the majority of pathologies than patients with a functioning transplant. The most frequent diseases presented by the dialysis patients apart from hypertension are arthropathy (34.9%); cardiomyopathy (17.9%); esophageal, gastric or duodenal disease (23.0%); and chronic hepatic disease (17.9%). In patients with a functioning transplant, the most frequent diseases are vascular disease (16.3%), cardiomyopathy (12.6%) and chronic hepatic disease (15.5%).

Table 9. Main concomitant diseases, 2001

Summarizing this section, Table 9 depicts the main concomitant diseases at the start of RRT in new cases from 2001 and concomitant diseases in all patients alive at the end of the year. A comparison between these results and those of last year shows that patients starting RRT this year had a slightly larger number of concomitant conditions, particularly those related to ischemic heart disease and cardiomyopathy, although these differences are not highly significant because of the small number of cases. A slight increase in some pathologies and a decrease in others is also seen for the total of patients on 31 December.

Among the patients alive on 31 December, 324 had concomitant diabetes mellitus (DM). Among these, 229 patients (70.7%) had DM Type 2, 59 patients (18.2%) had DM secondary to other diseases, 7 patients (2.2%) had DM Type 1 and the remaining 28 patients (8.6%) had non-specific DM.

Malignant processes

Figure 58 shows the distribution of malignant processes by gender. The most frequent in men are skin (3.0%) urinary tract (3.1%) and genital tract (2.1%) neoplasms. In women the most frequent neoplasms include those of the breast (2.4%), skin (1.8%), urinary tract (1.2%) and genital tract (1.2%). The groups of older patients have a larger number of concomitant malignant processes (urinary, genital and gastrointestinal tract), except for skin cancers, which affect patients 45 to 64 years old more frequently.

The 1995 Statistics Report can be consulted for a more in-depth knowledge of this subject. In that document the development of malignant diseases along the entire period of RRT was studied by actuarial methods according to several factors, such as type of treatment, site of origin of the neoplasm, gender, and age group.

This year the study on the probability of developing a malignant process used data from new cases in the period 1990 to 2001. The overall probability of developing a malignant process after the start of RRT was found to be 9.9% at 5 years and 16.6% at 10 years, and was higher for men than women (p=0.0005). By gender, the probability was 10.5% for men and 7.8% for women at 5 years after the start of RRT and 18.3% and 12.4%, respectively, at 10 years.

Figure 58. Distribution of malignant processes by gender. Cases on 31 December 2001

Another factor demonstrating statistically significant differences was age. The probability of developing a malignant process increases considerably in the more advanced age groups. At 10 years after the start of RRT the proportion is 17.2% in the 45 to 64 year-old group, 23.1% in the 64 to 74 year-old group and 30.6% in the over 74 year-old group (p<0.0001).

Table 10 depicts the probability of developing several types of neoplastic processes at 5 years and 10 years after the start of treatment (dialysis or transplantation). The most frequent are those of urogenital and gastrointestinal origin and those of the skin.

Table 10. Probability of developing malignant processes in RRT patients, 1990-2001

Hepatitis C virus

For a number of years now the Registry has been gathering information on hepatitis C virus (HCV) infection, taking advantage of the annual update and paying special attention to the follow up of patients who initiated renal replacement therapy from 1995 on. For this reason calculation of the probability of developing HCV serology has been performed only in the patients starting RRT from that date on.

The percentage of cases in which this information is missing has continued to decrease, with figures of 8.9% (504 patients) in 1998, 7.8% (462 patients) in 1999 and 3.4% (210 patients) this year. Many of the cases in which this data is missing are transplant patients

in whom serology is not known or has not been recorded.

The percentage of patients with antibodies against HCV according to the last treatment are shown in Figure 59. Excluding patients in which this information was not recorded, the percentage of patients with HCV antibodies on 31 December 2001 was 17.3% in those receiving HD, a proportion lower than the previous year, and 21.3% in those with a functioning transplant, also lower than the year before. The percentage of HCV-infected patients among those receiving peritoneal dialysis (9.2%) continues to be lower than that of the other treatment groups.

Figure 59. Percentage of patients with antibodies against HCV according to the last treatment. Cases on 31 December 2001

Figure 60. Probability of developing HCV seroconversion. New cases 1995-2001

The overall rate of seroconversion in patients starting treatment from 1995 to 2001 (n=5.369) was 1.52 seroconversions per 100 person-years of follow up. This year the probability of HCV seroconversion was also calculated according to time on RRT. It is an approximate analysis since the exact date of seroconversion is not available, only the year is known. With this information and considering that conversion was produced at the end of the year in which it was reported, the cumulative probability was calculated (Figure 60).

Degree of functional autonomy

This variable is assessed with a scale based on the Karnofsky activity scale adapted by Gutman for patients on dialysis treatment (GUTMAN, 1981). The scale is used to evaluate the level of functional capacity according to five categories:

1. Able to carry on normal physical activity (**Normal**).
2. Able to carry on nearly normal physical activity most of the time (**Nearly normal**)
3. Unable to carry on normal activity. Cares for self (**Limited**)
4. Requires assistance and frequent care. Dependent (**Special attention**)
5. Requires hospitalization or continuous care **(Continuous attention)**

Distribution according to level of functional capacity of patients starting renal replacement therapy this year was quite similar to previous years. Figure 61 shows that the percentage of patients starting RRT this year with a good level of functional capacity is comparable to that of the previous year. Among the total, 59.3% are able to carry on normal or nearly normal physical activity the greater part of the time, whereas a very small percentage of patients (0.7%) require hospitalization or continuous care. As seen in the figure, the distribution over time is very stable and there is a notable decrease in the percentage of cases in which this information is not reported.

Figure 62 depicts the distribution of patients by level of functional capacity on 31 December 2001 according to age groups. The percentage of patients able to carry on normal physical activities decreases with age. The proportion of children able to carry on normal physical activity is 79.2%, whereas the proportion of patients over 74 years old in this situation is 16.3%. The variations in the group of patients under 15 are due to the small number of cases and therefore, are not evaluable.

Functional capacity is seen to be affected by certain pathologies, such as diabetes and vascular disease. Only 33% and 49%, respectively, of patients with these conditions have normal functional capacity levels, whereas more than 75% of patients with glomerulonephritis and polycystic renal disease have normal or nearly normal capacity. More than 90% of transplant recipients have a normal or nearly normal level of functional capacity.

Figure 61. Level of functional capacity of new cases by year of initiation of RRT, 1993-2001

Figure 62. Level of functional capacity by age group. Cases on 31 December 2001

Cardiovascular risk factors

The study that will now be presented has been conducted using the criteria of the National Cholesterol Education Program (NCEP) Adult Treatment Panel III (ATP-III), revised in 2001. It includes the 31 December data collected on dyslipidemia and other variables recorded in the Registry (presence of cardiovascular disease, obesity, diabetes, etc.). Following this classification, the only information that is not included is data on first degree family history of coronary disease.

Patients on RRT have an elevated risk of developing cardiovascular disease. In the following analyses the specific criteria used are an adaptation of the NCEP ATP-III. Patients with dyslipidemia are considered to be those having cholesterol levels higher than 199 mg/dl and obese patients are those having a body mass index higher than 30. High cardiovascular risk is defined by the presence of diabetes, ischemic heart disease, cerebrovascular disease or peripheral vascular disease. Moderate cardiac risk is defined by the presence of one or more of the following factors: age over 45 years in men or over 55 years in women, smoking, arterial hypertension, and dyslipidemia. Low risk is defined by the presence of only one of the aforementioned factors.

Although this data was requested from all patients alive on 31 December, compliance was better among dialysis patients than among patients with functioning transplants. The analysis is presented according to the last type of treatment received.

Results

Among the 6362 patients on RRT alive on 31 December 2001, information regarding cholesterol was obtained in 87.0% of cases; thus an estimation of dyslipidemia could be made. The remaining variables (age, hypertension, cardiovascular disease, diabetes, obesity and smoking habit) that were needed to determine the levels of cardiovascular risk, were extracted from the Registry.

Figure 63. Cardiovascular risk factors NCEP (ATP-III-2001), 2001

Figure 64. Cardiovascular risk factors according to last treatment received, 2001

Figure 64 demonstrates the levels of cardiovascular risk according to the last treatment. Some 14% of patients in each of the treatment groups had a low cardiovascular risk; the differences are found in the distribution of the two other risk levels. High cardiovascular risk is present in 67% of patients on hemodialysis, 53% of those on peritoneal dialysis and only 30% of those with a functioning transplant.

Assessment of each risk factor separately shows that the most relevant are age, present in 83.3% of hemodialysis patients, and high blood pressure, present in 82.2% of peritoneal dialysis patients. Cardiovascular disease was found in 53% of HD patients and 28% of patients with a functioning transplant. Cardiovascular disease is defined as one or more of the following conditions: ischemic heart disease, cerebrovascular disease or peripheral vascular pathology. Diabetes, obesity and tobacco consumption are factors involving smaller percentages of patients.

In the 17th Statistics Report, corresponding to data from the year 2000, the assessment of dyslipidemia and cardiovascular risk factors is carried out in greater depth.

Survival

Survival of patients receiving renal replacement therapy

Overall survival of patients residing in Catalonia who started renal replacement therapy during the period of 1984 to 2001 is shown in Figure 65. First-year survival is 86.6%, 5-year survival is 55.6% and 10-year survival is 35.4%. The median time of survival was higher than 6 years.

Figure 65. Survival of patients receiving renal replacement therapy. New cases, 1984-2001

Figure 66. Survival of patients receiving renal replacement therapy according to age at the start of treatment. New cases, 1990-2001

Table 11. Univariate and multivariate survival analyses in patients over 14 years old receiving RRT (Cox regression). New cases 1990-2001

Analysis of survival by age groups (Figure 66 and Table 11) shows poorer rates at 5 years. Five-year survival is only 22% in patients over 74 years old.

Survival in children is slightly lower than in young adults, particularly in the first years. By the fifth year, the rates are similar (95% in the first year and 90% in the fifth year). In Figure 66 it can be seen that the differences in probability of survival for patients 20 to 50 years old are relatively small in the first years, and thereafter increase with increasing age and follow up time. Table 11 presents univariate analysis (at one and five years) and multivariate analysis survival results in new cases over 14 years old (1990-2001), performed with the Cox regression method (COX, 1972). The weight of each of the following factors is studied: gender, age, PRD, level of functional capacity, situation regarding transplant waiting list, and morbidity at the start of treatment (only statistically significant conditions appear in the table).

The first column contains the factor studied; the second, the number of patients included in each of the categories for each variable; the third, the univariate probability of first-year survival; the fourth, the univariate probability of fifth-year survival; and the fifth, the multivariate risk, i.e. the risk adjusted according to other factors. For example, when the other factors under study (PRD, functional capacity, waiting list status and concomitant disease) are equal, patients belonging to the 45 to 64 year-old age group at the beginning of treatment have a 2.55-times higher risk of death than those belonging to the 15 to 44 year-old group. In the case of qualitative variables, the first category of each of these is taken as the reference and is assigned a risk value of one. Thus, after adjusting for the

other variables studied, patients with diabetic nephropathy have a 1.68-times higher risk of death than patients with glomerular disease do. These results are very similar to those found in previous years (VIDAL, 1991). The last column contains the 95% confidence interval for multivariate risk.

These analyses disclosed considerable differences in survival according to primary renal disease. Patients with glomerular or polycystic diseases show similar results in the first three years, and have the highest survival rates (around 95% in the first year). Nevertheless, the differences increase over time; fifth-year survival is 69% in patients with glomerular disease and 79% in patients with polycystic disease.

In patients with interstitial pathology, one- and five-year survival rates are 89% and 64%, respectively. Survival values are similar in patients with vascular disease, other pathologies, and pathologies of unknown origin, with one-year rates of 81%, 80% and 86%, respectively, and 5-year rates of 44%, 46% and 52%. Diabetics have the poorest survival rates (80% at the first year and 31% at the fifth). After adjusting for other factors influencing survival, it can be seen that patients with polycystic disease have the lowest risk of death, whereas patients having other primary renal diseases and diabetic patients have the highest risk (Table 11, multivariate risk).

Survival was also analyzed according to several factors related to morbidity at the time of initiating renal replacement therapy, such as level of functional capacity, situation on the waiting list and certain concomitant diseases. The worse the patients' level of functional independence is at the time of starting treatment, the worse are the one- and five-year survival rates. The risk of death adjusted for the remaining factors is 2.51 times higher in patients that need special attention than in those with a normal level of functional capacity.

Survival of the dialysis patient

Hemodialysis

Table 12. Univariate and multivariate survival analyses in HD patients more than 14 years old (Cox regression). Treatment sequences 1990-2001

In this section survival is studied in patients receiving hemodialysis treatment. The unit of analysis is the sequence of treatment. Table 12 shows the results obtained in the univariate and multivariate survival analyses of patients on hemodialysis. Statistically significant variables were included in the model. The results are very similar to those found in the overall analysis of RRT patients; the only differences are in some of the concomitant pathologies that significantly affect patient survival. The remaining variables show similar findings.

Peritoneal dialysis

Table 13. Univariate and multivariate survival analyses in PD patients more than 14 years old (Cox regression). Treatment sequences, 1990-2001

Survival in patients receiving peritoneal dialysis was also analyzed separately. No differences in survival were found as related to gender or primary renal disease, but there were differences relative to age at the initiation of treatment (Table 13). Patients over 74 years old had a 3.68-times greater risk of death than those 15 to 44 years old,

after adjusting for all the other factors. Furthermore, patients requiring special attention had an approximately 4-fold higher risk of death than those with normal functional capacity. Statistically significant concomitant diseases at the start of treatment included cardiomyopathy, diabetes and chronic liver disease.

Survival of the transplant recipient and graft survival

To provide a more up-to date view of these results, the majority of data presented in this section belong to the period of 1990 to 2001. Figure 67 shows survival data for 5,035 grafts from cadaveric donors transplanted in Catalonia during the period 1984 to 2001: 5-year survival is 69% and 10-year survival is 49%. After the first year post-transplantation, the possibility of losing the graft is less than 5% annually. Survival of the recipient is 90% at 5 years and 81% at 10 years. Death occurs mainly during the first year and annual rates are less than 2%. These results are quite satisfactory, particularly taking into account that the Registry includes information on all patients, a considerable number received transplants more than 10 years ago, and more than 20% of recipients are over 54 years old. It is important to remember these factors when comparing data from the Registry with those from other similar studies. The results for patients receiving grafts from living donors are even better. Survival in patients receiving living-donor grafts is 96% at 5 years and 91% at 10 years, and graft survival is 77% and 58%, respectively).

Figure 67. Patient and graft survival in cadaveric organ transplantation. Transplants 1984-2001

Table 14 summarizes patient and graft survival at one, three, and five years for different types of transplants and periods. The results obtained are very similar to those presented in previous years.

This year the study of kidney transplantation by periods has been divided into three intervals: 1984-1989, 1990-1994 and 1995-2001. There are some differences with regard to patient survival between the last period and the two previous periods. Graft survival results show progressive improvement with each period, though it is more marked between the first two than between the later ones. When viewing these analyses it must be remembered that there has been an increase in the age of recipients and in the number of risk factors involved, as was described in the section on recipient characteristics. This also applies to graft survival, since the characteristics of donors have also changed in recent years (older, and fewer deaths due to cranioencephalic trauma); nevertheless, despite these factors, graft survival has also improved. The period 1998 to 2001 has also been maintained, since a considerable change in graft survival was observed last year.

Table 14. Survival of the patient and graft according to type of transplant and period (actuarial analysis).

Figure 68. Graft survival in cadaveric organ transplantation according to periods, 1990-1997 and 1998-2001

Table 15. Survival of patients with renal transplants from cadaveric donors according to recipient age and primary renal disease (actuarial analysis). Transplants, 1990-2001

Figure 69. Graft survival in cadaveric organ transplantation, according to donor age. Transplants, 1990-2001

Figure 70. Graft survival in cadaveric organ transplantation, according to donor and recipient age. Transplants, 1990-2001

Because of the increasingly higher number of patients who receive more than one transplant (482 in the period 1990 to 2001), retransplantation is now analyzed separately. The differences in recipient survival between the first and second transplant are not significant. With regard to graft survival, the results are higher in first transplantations. At three years survival of the second transplant is 73%, more than 8% lower than first-transplant survival ($p<0.0001$). These values indicate a very acceptable probability of survival for patients facing a second opportunity.

Figure 71. Graft survival in cadaveric organ transplantation, according to donor and recipient gender. Transplant 1990-2001

Analysis of survival according to the age at which patients received a transplant (Table 15) reveals a 5-year survival rate of 94% in patients under 55 years old. This value gradually decreases with increasing recipient age: 87% for patients 55 to 59 years old, 80% for patients 60 to 64 years old and 70% for patients over 64. Survival analysis by primary renal disease (Table 15) demonstrates values very similar to those from other years. The 5-year probability of survival is 91% for patients with standard PRD, 83% for diabetic patients and 87% for those having other PRDs ($p=0.001$).

In Figure 69 one can see that survival of the graft is progressively lower with increasing age of the donor. This trend is especially marked when donor age is over 60 and, above all, when it is over 70.

Figure 70 summarizes graft survival as related to age of the **recipient** (**young**: under 60 years old and **old**: more than or equal to 60 years old) and to age of the **cadaveric donor** (**young**: under 60 years old and **old**: more than or equal to 60 years old). These age groups are the same ones used for the section presenting data relative to the donor.

Graft survival in patients 60 years old or more is similar whether the kidney comes from a young donor or an old donor, whereas in recipients less than 60 years old graft survival varies considerably according to the age of the donor. Five-year survival is 76% in young recipients receiving a graft from a young cadaveric donor and 60% in young recipients receiving a graft from an old cadaveric donor ($p<0.00001$).

Table 16. Univariate and multivariate analyses of graft survival (Cox regression). Cadaveric transplants 1990-2001

As can be seen in Figure 71, there were no statistically significant differences in overall graft survival as related to donor and recipient gender. Better graft survival is seen in the cases in which donor and recipient sex coincide, but statistically significant results are only found in cases of male recipients with grafts from male donors.

Table 16 presents the results obtained in univariate and multivariate analyses of graft survival using an actuarial method and Cox regression, respectively. As mentioned previously, the multivariate analysis takes into account all the factors studied that can

influence survival (introduced in the regression) and calculates the risk for each of them, adjusting for all the others. In this case the factors studied are donor and recipient age at the time of transplantation, the maximum and minimum percentages of antibodies, HLA-DR matching, and whether or not the patients had diabetes mellitus, cardiac conduction abnormalities or chronic obstructive pulmonary disease.

In summary, graft survival as related to HLA-DR matches between donors and recipients of cadaveric grafts transplanted in Catalonia during the 1990-2001 period is better in the group of patients with transplants having two HLA-DR matches. Five year survival is 74%, a value 8% higher than that of patients receiving a transplant with no matches (p=0.002). These data confirm the trend observed in prior transplant series, as published in reports from other years. No statistically significant differences in graft survival were found between *locus A* and *locus B* matches.

Recipients having antibodies against HLA antigens before transplantation require grafts from donors presenting antigens against which the recipient's antibodies will not react. This is one of the most important obstacles to finding suitable donors. Analysis of graft survival according to the recipient's anti-HLA reactivity, as determined by the panel reactive antibodies (PRA) test, is performed by separate study of the presence of antibodies immediately prior to transplantation (final-PRA) and the maximum level of antibodies presented by the patient at any time during treatment (maximum-PRA). For patients with no anti-HLA reactivity (maximum-PRA 0% to 10%), 5-year graft survival is 73%, for those with low reactivity (maximum-PRA 11% to 50%) graft survival is 69% and for those with high reactivity (hypersensitive, maximum PRA >50%) graft survival is 63%. This difference is also observed when studying only the percentage of antibodies at the time of transplantation: 5-year graft survival is 73% for recipients with no anti-HLA reactivity (final-PRA 0% to 10%), 64% for those with low reactivity (final-PRA 11% to 50%) and 58% for those with high reactivity (final PRA >50%). These data indicate that the presence of antibodies against HLA antigens in the recipient is one of the most important factors affecting renal graft survival. Thus, recipient reactivity at the time of transplantation, even though it may be low, is an essential factor to take into account when deciding long-term immunosuppressor dosage.

Some years ago retrospective data collection was initiated for the following variables: presence of acute tubular necrosis, cold ischemia time and days on dialysis post-transplantation. Although we still have a high percentage of patients in whom this information was not recorded, Figure 72 shows graft survival in patients alive after the first year with a functioning transplant, as related to the presence or not of acute tubular necrosis. Three- and five-year survival was 91% and 77%, respectively, in patients presenting tubular necrosis and 93% and 85%, respectively, in patients without tubular necrosis (p<0.00001).

Figure 72. Graft survival in patients alive the first year with a functioning cadaveric kidney, according to presence of acute tubular necrosis. Transplants, 1990-2000

Mortality

Mortality in patients receiving renal replacement therapy during 2001 was 9.8% (691 patients): **15.3%** in the **hemodialysis** group, **13.2%** in the **peritoneal dialysis** group and **2.0%** in the **functioning transplant** group. The number of patients on RRT who died during 2001 is higher than the year before, but the percentage over treated patients has passed from 9.9% to 9.8%. The distribution of causes of death is practically identical.

The main cause is cardiac disease, accounting for 30.0% of all deaths this year (Table 17). The group of deaths due to unknown causes is still substantial, despite the fact that this year there has been another decrease as compared to the year before.

Table 17. Distribution of causes of death, 2001

More detailed study of the causes of death in this population over the last three years (1999-2001) discloses that mortality increases with increasing age, showing an incidence of 0.8 deaths per 100 person-years in children, passing to 33 deaths per 100 person-years in patients over 74 years old (Table 18). Cardiac disease is the main cause of death in adults, with an incidence of 0.9 deaths per 100 person-years in the 15 to 44 year-old group and 10.1 deaths per 100 person-years in the over 74-year old patients. A similar pattern, though not so pronounced, is seen in the incidence of death due to vascular disease and infectious disease. Mortality due to neoplastic disease and miscellaneous causes (above all cachexia) mainly involves patients over 64 years old.

Table 18. Distribution of causes of death according to age groups, expressed in percent terms (per 100 person-years). New cases, 1999-2001

Table 19. Distribution of causes of death according to PRD, expressed in percent terms (per 100 person-years). New cases, 1999-2001

Table 20. Distribution of causes of death according to treatment, expressed in percent terms (per 100 person-years). Treatments, 1999-2001

Table 19 shows the distribution of causes of death according to primary renal disease. Considerable differences are apparent. Mortality in diabetic patients (22.3 per 100 person-years) is more than triple that of patients with glomerular disease (6.4 per 100 person-years) and mortality in patients with vascular renal disease (16.4 per 100 person-years) is more than double that of glomerular disease patients. Cardiac pathology is the main cause of death in all the primary renal disease groups, though with variations in incidence. Death due to vascular problems and infections is most frequent in diabetic patients, vascular renal disease patients, renal disease of unknown etiology, and the group of other causes.

Mortality as related to the type of treatment was studied by analyzing the treatments started in the period 1999 to 2001, regardless of whether or not they were first treatments (Table 20). For all the treatment groups, the most frequent cause of death is cardiac disease, followed by vascular disease. Infectious disease is particularly important in the patients receiving peritoneal dialysis.

Figure 73. Distribution of causes of death while receiving RRT, 1990-2001

Figure 74. Number of patients that died during the first year of RRT. New cases 1984-2001

Figure 73 shows the distribution of causes of death over the first five years of RRT. The analysis was performed with the new cases during the 1990 to 2001 period. No time pattern was observed in the distribution of causes of death; percentages remain similar regardless of the time on RRT. Thus, mortality due to cardiac disease is most frequent, near 35% at all intervals studied. Miscellaneous disease as a cause of death shows

increases, with a rate of 8.6% in the first year to nearly 12.3% in the fourth year of treatment, whereas death due to unknown causes remains within a range of 9.7% to 10.9%. The remaining causes do not show a specific pattern of incidence.

Figure 74 depicts the evolution of mortality during the first year of treatment, both in absolute numbers (the values represented by the columns is found in the left axis: number of patient deaths) and in the percentage over the annual incidence (the value represented by each of the points on the line has to be read in the right axis: percentage). There is a growing tendency in the number of patients that die before completing one year of RRT. In contrast, the percentage that this number of patients implies in the annual incidence is seen to fluctuate over the years, with a strong increase in the last four. Among the new patients in 1986, 9.4% died during the first year of treatment. In 1992 the proportion increased to 14.6%; subsequently there was a decrease to 9.6% in 1993 and again an increase to 13.1% in 1994 and 18.2% in 1995. In 1997 it decreased once again and later there was a new increase. The rate in 2000 was 17.0%. Mortality in patients initiating treatment in 2001 cannot be analyzed as yet because some patients have still not completed the first year of therapy.

Figure 75. Mortality rates during the first year of RRT by age groups. New cases, 1990-2001

Figure 76. Standardized mortality ratios (SMRs) during the first year of RRT (95% confidence interval). New cases, 1990-2001

First-year mortality was also analyzed according to age groups and compared with the overall mortality in the Catalan population. Figure 75 shows mortality in Catalonia by age groups for the year 1996 and the mortality rates for RRT patients by age group during the first year of treatment. Specific rates for the renal patients have been calculated starting from the mortality of the first year of treatment in the group of patients starting RRT between 1990 and 2001. The figure shows that mortality rates in the Catalan population and in the RRT population increase with increasing age. Mortality rates in the RRT population are much higher for all the age groups. Figure 76 depicts the ratio between these two rates. Even though the group of patients over 84 years old presents the highest mortality (more than 414.3 per 1000 patients), this rate is only 2.5 times higher than that of the Catalan population, whereas mortality for the 45-54 year-old group (48.2 per 1.000 patients) is 15.2 times higher than the Catalan population in the same age group. Overall, the RRT population has a mortality rate 7.4 times higher than that of the Catalan population.

Geographic distribution

Geographic distribution of resources

As decided in the Order of 16 June 1987 for the implementation of the Program for the care of renal failure patients, the functional structure of nephrological services is established as follows (Figure 77):

Nephrology Departments (ND). Nephrology departments comprise the functional framework for attending renal failure patients in Catalonia and guarantee the options for end-stage renal disease replacement therapy. Their sphere of activity covers a specific geographic area. Among their functions, the nephrology departments perform the following:

- Collaborate in the planning of health care coverage.
- Carry out prevention and diagnosis of renal failure, and prescribe renal replacement therapy.
- Supervise the quality of all nephrological care units and dialysis centers, for which they act as referral services.
- Participate in the Renal Registry.
- In the case of departments with renal transplantation units (RTUs), take charge of the waiting lists for transplantation.
- Participate in training programs.
- Perform research tasks.

Nephrological care units (NCU). Nephrological care units are those forming a part of an accredited general hospital. They provide less complex nephrological care and also work as dialysis centers. They are functionally dependent on a nephrology department and also promote active programs of home dialysis.

Figure 77. Functional levels of nephrology care in Catalonia

Dialysis centers (DC). Under the supervision of a nephrology department, dialysis centers provide substitutive dialysis therapy to patients with end-stage renal disease and guarantee their clinical monitoring.

The geographic distribution of the resources for renal failure in Catalonia according to the various levels of care is shown in Figure 78.

Figure 78. Nephrological resources for the care of patients with chronic renal failure in Catalonia, 2001

Geographic distribution of the patients

Table 21 depicts the incidence rates for RRT patients from 1999 to 2001, age- and gender-adjusted by the indirect method and calculated for the population over 14 years old. Table 22 shows the prevalence rates for RRT patients from 1999 to 2001, age- and sex-adjusted by the direct method for the population over 14 years old. In these tables the first column represents the number of cases, the second the standard deviation and the third the standardized rate. With regard to incidence, it must be kept in mind that because of the small number of cases, small fluctuations can produces significant changes in the rates, an effect that does not occur with prevalence.

Table 21. Incidence of RRT patients over 14 years old by health region. Rates expressed per million population, 1999-2001

Table 22. Prevalence of RRT patients over 14 years old by health region. Rates expressed per million population, 1999-2001

Figure 79. Incidence of treated end-stage renal disease in patients over 14 years old by health region. Rates expressed per million population, 2001

Figure 80. Prevalence of treated end-stage renal disease in patients over 14 years old by health region. Rates expressed per million population, 2001

This effect is also observed in Figures 79 and 80, which show incidence and prevalence rates of treated end-stage renal disease corresponding to 2001 with their 95% confidence intervals. To calculate these rates the Catalan census for 1996 was used as reference population and age- and gender- adjusting was performed.

Figure 81. Prevalence of treated end-stage renal disease in rural and urban areas, 1984-2001

Figure 82. Age- and sex-adjusted prevalence of treated end-stage renal disease in rural and urban areas and urban areas, 1996-2001

Figure 81 shows the prevalence rates for RRT patients in rural areas (populations with less than 10,000 inhabitants) and urban areas (populations with more than 10,000 inhabitants). The changing rates observed in this graph indicate that the accessibility of RRT for the rural population improves during the earlier period; therefore, the distribution of nephrological resources for the care of chronic renal failure patients in Catalonia is more equitable. Nevertheless, the trends for the last three years are not so clearly favorable. This can be explained in part by the fact that the rates for the period 1996-2001 have been calculated with more recent background population figures, the 1996 Catalan census. For this reason, this later period has been analyzed for the population over 14 years old, after adjusting for age and sex. As can be seen, the prevalence rate for the urban population shows a clear trend to growth, whereas the prevalence rate for the rural population presents some fluctuations. In the year 2000 growth was dissimilar in the two areas, though this year the rural rate appears to have recovered somewhat.

Osteodystrophy study

Introduction

Taking advantage of the annual data collection to update the Registry, the study carried out in 1999 on osteodystrophy has been revised and brought up to date this year. For the purposes of this study, the following questions were included for all the patients on dialysis (hemodialysis and peritoneal dialysis):

In a single determination during 2001:
Parathyroid hormone (PTH) concentrations
Serum calcium values
Phosphorous values
Have you been treated with vitamin D?

Additionally, the following was asked:
Has the patient had a parathyroidectomy? If yes, specify the year.

Being a transversal study this work has some limitations. To avoid incongruent results regarding PTH and serum calcium levels, and vitamin D treatment, we asked that all values be taken from the same determination.

Results

Among 3521 patients alive and receiving dialysis on 31 December 2001, we obtained information on PTH in 96.9%, on serum calcium in 99.3%, on phosphorous in 99.3%, on vitamin D treatment in 97.9% and on the history of parathyroidectomy in 98.8%. The 219

patients who underwent parathyroidectomy were excluded from the general analysis.

Parathyroid hormone
In the majority of cases PTH was measured using immunoradiometric assay (IRMA).

Figure 1. Distribution of PTH levels according to gender. Cases in dialysis on 31 December 2001

Figure 2. Distribution of PTH levels according to vitamin D treatment. Cases in dialysis on 31 December 2001

Figure 3. Distribution of PTH levels according to presence of diabetes. Cases in dialysis on 31 December 2001

The data show that women, in general, have higher PTH levels than men do (p=0.001) (Figure 1). Among patients on dialysis treatment on 31 December 2001, mean PTH values are 251 pg/mL for men and 290 pg/mL for women (p=0.0003). There are no significant differences in PTH levels according to type of dialysis treatment. As PTH levels increase the percentage of patients receiving vitamin D treatment also increases (Figure 2). Statistically significant differences were also found with regard to presence or not of diabetes (p=0.001); diabetic patients have lower PTH levels than non-diabetic patients do (Figure 3). Analysis of mean PTH levels according to primary renal disease shows that diabetic patients have much lower levels than the remaining patients and that patients with interstitial etiology or polycystic renal disease have highest levels, though the differences are not statistically significant (Figure 4). In Figure 5 it can be seen that as the level of PTH increases, time on renal substitution treatment increases. Moreover, the percentage of patients undergoing parathyroidectomy also increases with time on RRT.

Figure 4. Mean PTH levels according to primary renal disease. Cases in dialysis on 31 December 2001

Figure 5. Mean PTH levels and percentage of patients who underwent parathyroidectomy according to time on RRT. Cases in dialysis on 31 December 2001

Mean PTH levels in patients who have been receiving renal replacement therapy for 5 years or more is higher than PTH levels in patients on RRT for less time. Nevertheless, in both groups the levels decrease with advancing age, particularly in patients over 50 years old (Figure 6).

Figure 6. PTH levels according to age group and time on RRT. Cases in dialysis on 31 December 2001

Serum calcium
Distribution of serum calcium levels shows no statistically significant differences (p=0.8) as related to gender or age group; nevertheless, there is a slight tendency to decreases with increasing age. In contrast, in the study of serum calcium levels according to primary renal disease, patients with diabetic nephropathy have significantly lower levels than the remaining patients do (Figure 7).

Serum calcium levels are seen to increase as time on RRT increases (Figure 8).

Figure 7. Mean calcium levels according to primary renal disease. Cases in dialysis on 31 December 2001

Figure 8. Mean calcium levels according to time on RRT. Cases in dialysis on 31 December 2001

Figure 9. Mean phosphorus levels according to time on RRT. Cases in dialysis on 31 December 2001

Phosphorus

No differences were found between mean phosphorus levels in men (5.5 mg/dl) and in women (5.6 mg/dl)), but there was a sight age-specific difference. In the 20 to 34 year-old group, phosphorus levels were 6.3 mg/dl, whereas in the over 74 year-old group, levels were 5.0 mg/dl ($p>0.0001$). As related with time on RRT, phosphorus levels remain quite stable (Figure 9).

The analysis of mean phosphorous levels according to primary renal disease demonstrated some differences. Diabetic patients and patients with renal disease of unknown etiology had significantly lower levels than the mean, whereas patients with glomerular disease had higher levels (Figure 10).

Figure 11 depicts the changes in the product of phosphorus times calcium according to time on RRT; slight increases are observed.

Vitamin D

Some 46.8% of men and 49.9% of women on dialysis receive treatment with vitamin D ($p=0.08$).

The percentage of patients taking vitamin D decreases slightly with age but increases with time on RRT. As shown in Figure 12, the percentage of patients treated with vitamin D is higher among those who have received RRT for 5 years or more in all the age groups.

Parathyroidectomy

Among patients receiving dialysis treatment on 31 December, 219 (6.2%) had undergone parathyroidectomy. Eleven of these patients had been operated on before starting RRT, whereas the remaining had received RRT for a mean of 8.8 years (SD=6.1 years) before the operation.

Figure 10. Mean phosphorus levels according to primary renal disease. Cases in dialysis on 31 December 2001

Figure 11. Mean levels of phosphorus times calcium, according to time on RRT. Cases in dialysis on 31 December 2001

The percentage of women who underwent parathyroidectomy (8.2%) is significantly higher than the percentage of men (5.1%) ($p=0.0003$). Analysis of the patients operated on according to age shows increases up to the 35 to 49 year-old group, with 14.1% of

operated patients, and then a continuous decrease to the group over 74 years old, with only 2.8% of patients undergoing parathyroidectomy ($p<0.00001$).

Figure 12. Percentage of patients taking vitamin D according to age group and time on RRT. Cases in dialysis on 31 December 2001