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Registry Report

Survival on Renal Replacement Therapy: Data from the EDTA Registry

F. P. Brunner	Departement für Innere Medizin, Universität Basel, Switzerland
M. Broyer	Hôpital Necker Enfants Malades, Paris, France
H. Brynger	Department of Surgery I, Sahlgrenska Sjukhuset, Göteborg, Sweden
S. Challah	St Thomas' Hospital, London, United Kingdom
S. R. Dykes	St Thomas' Hospital, London, United Kingdom
W. Fassbinder	Klinikum der Johann Wolfgang Goethe-Universität, Frankfurt am Main, Federal Republic of Germany
R. Oulès	Centre Hospitalier Regional et Universitaire de Nimes, France
G. Rizzoni	Ospedale Pediatrico Bambino Gesu, Istituto Scientifico di Ricerca, Roma, Italy
N. H. Selwood	UK Transplant Service, Bristol, United Kingdom
A. J. Wing	St Thomas' Hospital, London, United Kingdom

Abstract. Extensive survival data are presented from the EDTA Registry's files for patients who started renal replacement therapy in 1970–1974 compared to 1980–1984. The contribution of the different treatment modalities (haemodialysis, continuous peritoneal dialysis, and transplantation) to the survival of patients according to geographical region is also shown. Survival on renal replacement therapy, irrespective of treatment modality and of primary renal disease, was best in the 10–14-year-old patients, with 58% at 10 years and 52% at 15 years, and decreased with rising age to 28% at 10 years and 16% at 15 years in patients aged 45–54 when they commenced therapy in 1970–1974. When comparing the 0–4-year-old with the 10–14-year-old cohort of the paediatric patients, 5-year survival rates for patients starting renal replacement therapy in the early eighties declined from 85% to 70% with decreasing age.

Treatment policy, as reflected by the proportion of patients on different modes of therapy, varied markedly between European regions but affected survival to a small extent only. The large population with diabetic nephropathy incurred annual mortality rates 2–3 times greater than those observed in patients with 'standard' primary renal diseases. Haemodialysis and continuous peritoneal dialysis, although not comparable because of important differences in selection policy, yielded similar survival rates.

Patient and graft survival rates have improved markedly when comparing patients starting renal replacement therapy in the early seventies with the eighties; particularly for cadaveric transplantation. Patient survival after second grafting was similar to that after first grafting, with 83% at 5 years after second cadaveric grafting in the 15–44-year-old cohort, vs 85% after first

Correspondence and offprint requests to: Prof. F. P. Brunner, European Dialysis and Transplant Association Registry, St Thomas' Hospital, London SE1 7EH, UK.

cadaver transplantation in 1980–1984. Second cadaveric graft survival was superior to average first-graft survival for those recipients whose first graft had been functioning for more than 1 year. However, second-graft survival in rapid rejectors of a first graft as well as third cadaveric graft survival were curtailed by the large number of early losses, with only 52% of third grafts functioning at 1 year. For living related donor transplantation, parents were mostly used in children whilst identical siblings predominated in adults older than 45. In the early eighties, patient survival was 92% at 5 years for recipients younger than 15, 87% for the 15–45 year old cohort and 72% for those aged 45 or older. From the overall survival rates on renal replacement therapy obtained at 5 years in the early eighties, it appears safe to predict that at least 65% of young adults and 25% of patients aged 55–64 will be surviving at 10 years after starting therapy.

Key words: EDTA Registry; Diabetic nephropathy; Graft survival; Patient survival after renal transplantation; Regraft survival; Survival on CAPD; survival on haemodialysis; Survival on renal replacement therapy

Introduction

The EDTA Registration Committee has been asked by many members of EDTA–ERA to provide comprehensive survival data for patients on renal replacement therapy in Europe. Particular interest is anticipated, on the one hand for survival achieved in recent years, and on the other hand for long-term survival beyond 10 years. It seemed appropriate, therefore, to present survival data for patients starting treatment during the first 5 years of the last decade (1970–1974) and compare them to the cohort starting from 1980 to 1984. Factors that might affect survival such as age and primary renal disease are also taken into account. Finally, the contribution of different methods of treatment to the survival on renal replacement therapy is examined in relation to age of patients at start of treatment and its wide variation between geographical regions.

Methods

The methods of data collection used by the EDTA Registry have been described previously [1]. This report is based on data provided on individual patient questionnaires and relates to treatment up to 31 December 1985. Patient and graft survival estimates were calculated using the actuarial method, and calculations to define the proportional contributions of the various treatment modalities to renal replacement therapy and patient survival were carried out by the methodology developed by Dr. Neville Selwood and previously described [2].

Survival After First Renal Replacement Therapy

Survival on renal replacement therapy has improved markedly in one decade. This is readily apparent for all age groups up to 65 shown in Table 1 and to a lesser extent also for the group aged over 65 at start of treatment. However, the survival figures given in Table 1 for patients over 65 may not usefully be compared, as the large difference in the numbers of patients in this group for the two periods studied was due to a substantial number of 70–80-year-olds beginning renal replacement therapy in 1980–1984. It is possible that the more liberal intake of older patients in recent years has also included an increasing number of high-risk candidates. It is no surprise that survival on renal replacement therapy still does not approach survival rates of the general population which, according to official statistics from many European countries, show an annual mortality of some 0.05% for children aged 5–14 years, of 0.1%–0.2% for young adults aged between 15 and 45 years, of 0.3%–0.8% for the 45–54 age cohort and of 0.7%–1.0% for females and 1.5%–2.0% for males aged 55–64 [3].

Annual mortality on renal replacement therapy decreased with length of time on therapy, which is demonstrated in a semilogarithmic plot (Fig. 1) by an upturn in the survival curves [4]. This was more apparent in the younger as compared to the older cohorts, and also in those starting treatment in the early seventies as compared to those starting in the early eighties. That annual mortality decreased with time on renal replacement therapy is also shown in Fig. 2 for the three large age cohorts starting treatment in 1970–1974. Annual mortality decreased from 13.5% during the first year of therapy to 2%–3% at 10–15 years in the 15–34-year-old cohort, from 16% to 5%–7.5% in those aged 35–44 at start of therapy, and from 17% to 10%–11% in the 45–54-year-old group. Decreasing mortality with time is encouraging, since rising age is, in general, associated with a steady increase in mortality.

Most likely explanations for this finding include the more rapid drop-out of high-risk patients, such as young patients with diabetes mellitus, higher transplantation rates in the early years on renal replacement therapy with increased mortality in the first few months after transplantation, and improving quality of treatment in the course of the last 10–15 years. Figure 3 suggests that improving quality of renal replacement therapy is unlikely to be the sole explanation. This compares the interval mortality of two age cohorts. Those patients who commenced renal replacement therapy in 1980–1984 (shown

Table 1. Patient survival after first renal replacement therapy, according to age at start of treatment. Results are given according to year of first renal replacement therapy (RRT). Number of patients at risk at time zero (n) is shown. An asterisk (*) denotes less than 30 patients at risk

Age at first RRT (years)	Year of first renal replacement therapy												
	1980–1984						1970–1974						
	n	% Survival					n	% Survival					
		1 yr	2 yr	3 yr	4 yr	5 yr		2 yr	4 yr	6 yr	8 yr	10 yr	12 yr	15 yr
0–4	297	86	80	75	73	70	34	59	*	*	*	*	*	*
5–9	676	91	87	85	82	82	182	70	55	47	44	43	41	*
10–14	1 404	96	91	89	87	85	570	80	72	66	61	58	57	52
15–34	18 972	93	88	85	82	80	9 404	78	68	62	58	54	51	48
35–44	15 048	91	84	79	74	70	7 073	73	59	51	45	41	35	28
45–54	21 866	90	81	74	67	61	7 160	71	54	44	35	28	23	16
55–64	21 885	86	74	65	57	49	3 251	64	43	30	21	14	10	*
≥65	16 562	78	61	49	39	31	584	56	33	20	12	7	*	*

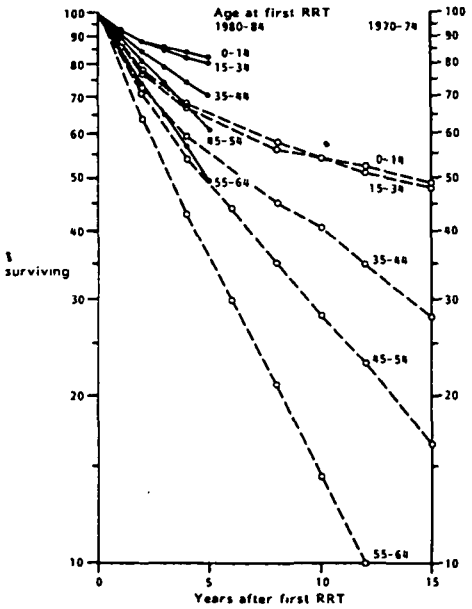

Fig. 1. Patient survival after first renal replacement therapy according to age group and year at start of treatment.

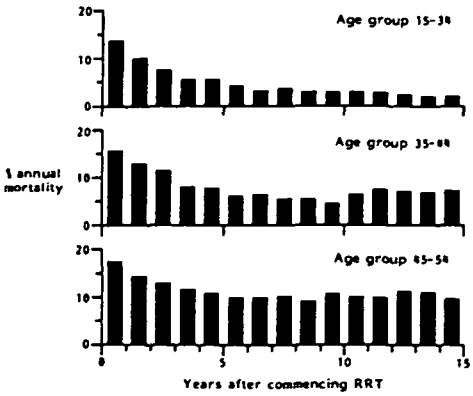

Fig. 2. Annual mortality after first renal replacement therapy (RRT) 1970–1974, according to age group.

in the left panel) had higher annual mortality rates than their counterparts of the same age who had spent 10 additional years on treatment (right panel). Although interval mortality was decreasing less with time in the cohort commencing treatment in 1980–1984, it would seem safe to predict that survival at 10 years for patients who commenced renal replacement therapy in 1980–1984 would be going to exceed 72% (i.e. 85% of 85%, Table 1 and Fig. 1) for the paediatric cohort aged 10–14 years and 25% (i.e. 50% of 50%) for the 55–64-year-old cohort.

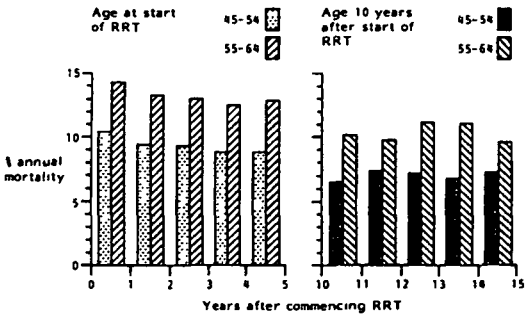

Fig. 3. Annual mortality on renal replacement therapy (RRT) 1980–1985, according to age group.

Survival on Renal Replacement Therapy in Different Regions of Europe

In order to compare geographical differences in the approach to renal replacement therapy, six groups of countries were studied. The proportional use of different methods of therapy were similar within each of the groups. Comparison between these groups of countries should highlight different survival trends on the European scene. Patient survival figures computed for these geographical regions (Table 2) can be regarded as a summary of the results of national programmes. (National

Table 2. Patient survival after first renal replacement therapy (RRT), according to age at start of treatment in six regions of Europe

Age at first RRT (years)	Year of first renal replacement therapy											
	1980-1984						1970–1974					
	n	% Survival					*n*	% Survival				
		1 yr	2 yr	3 yr	4 yr	5 yr		2 yr	4 yr	6 yr	8 yr	10 yr
Latin (France, Italy, Portugal, Spain)												
0-14	867	95	91	89	87	85	286	80	71	64	60	58
15–44	10 113	97	93	91	88	85	5 510	84	74	68	63	59
45–64	15 505	92	84	76	70	64	3 672	78	60	48	39	31
≥65	6 798	81	64	52	41	33	272	63	38	23	16	*
Benelux (Belgium, Luxembourg, Netherlands)												
0–14	149	95	91	89	87	85	65	82	80	75	75	75
15–44	1 395	95	92	89	86	83	1 143	81	72	64	60	55
45–64	2 348	88	79	70	62	55	911	79	60	47	36	26
≥65	1 145	78	63	50	38	30	40	68	*	*	*	*
British Isles (United Kingdom, Ireland)												
0–14	359	93	91	87	85	85	144	77	62	57	51	47
15-44	3 649	94	89	86	83	80	2 473	77	65	58	53	49
45–64	3 830	84	73	65	57	50	956	65	48	38	30	23
≥65	609	69	53	44	33	20	7	*	*	*	*	*
Federal Republic of Germany, Austria												
0–14	285	95	94	93	92	92	134	75	65	60	55	52
15–44	5 072	95	89	85	82	80	3 215	74	62	55	50	46
45-64	8 886	88	78	69	61	54	2 300	64	47	36	28	21
≥65	3 877	79	61	49	40	32	145	54	32	19	*	*
Nordic (Denmark, Finland, Iceland, Norway, Sweden)												
0–14	93	93	90	88	85	*	53	81	74	70	64	62
15–44	1 609	88	81	76	72	69	1 078	70	57	51	47	44
45–64	2 080	79	67	56	50	44	1 210	54	38	27	22	17
≥65	849	66	48	35	28	21	50	*	*	*	*	*
Eastern (Bulgaria, Czechoslovakia, GDR, Hungary, Poland)												
0-14	173	83	73	72	70	*	34	*	*	*	*	*
15-44	3 671	86	73	64	56	52	1 262	45	29	20	16	13
45 64	2 341	80	63	49	41	34	408	40	19	10	6	*
≥65	72	74	38	*	*	*	1	*	*	*	*	*

Number of patients at time zero (*n*) is shown
An asterisk (*) denotes less than 30 patients at risk

survival figures were given in the Combined Report on Regular Dialysis and Transplantation in Europe, XVI, 1985, which was provided for all the renal units supplying their patient data to the EDTA Registry.) Survival rates differed little between the Latin group of countries, where the proportional contribution of transplantation has been relatively small, and the Benelux countries and the British Isles where transplantation rates have been intermediate. Lower survival was obtained in the Nordic countries with their traditionally high transplantation rates. Eastern countries showed low survival rates and the contribution of transplantation was small.

The proportional contribution of hospital (or centre) haemodialysis, home haemodialysis, intermittent peritoneal dialysis, continuous peritoneal dialysis and transplantation to patient survival in the six geographical regions is shown in Fig. 4 for the two large cohorts aged 15–44 and 45–64 years at commencement of renal replacement therapy in 1980–1984, and in Fig. 5 for patients aged 15–44 years who commenced renal replacement therapy in 1970–1974. The contribution of transplantation was larger and that of hospital haemodialysis smaller in paediatric patients of all regions, whilst the opposite, a larger contribution of hospital haemodialysis and a smaller contribution of transplantation, was observed in the older age groups than are shown in Figs 4 and 5.

Figure 6 summarises interval mortality on all forms of treatment as well as separately on hospital haemodialysis, home haemodialysis, continuous peritoneal dialysis and with a functioning graft (primary or regraft, and all sources of donor kidney) for patients commencing treatment in the six geographical regions in 1980–1984. There were clearly marked differences between geographical regions in annual death rates (i.e. the proportion of patients at risk in

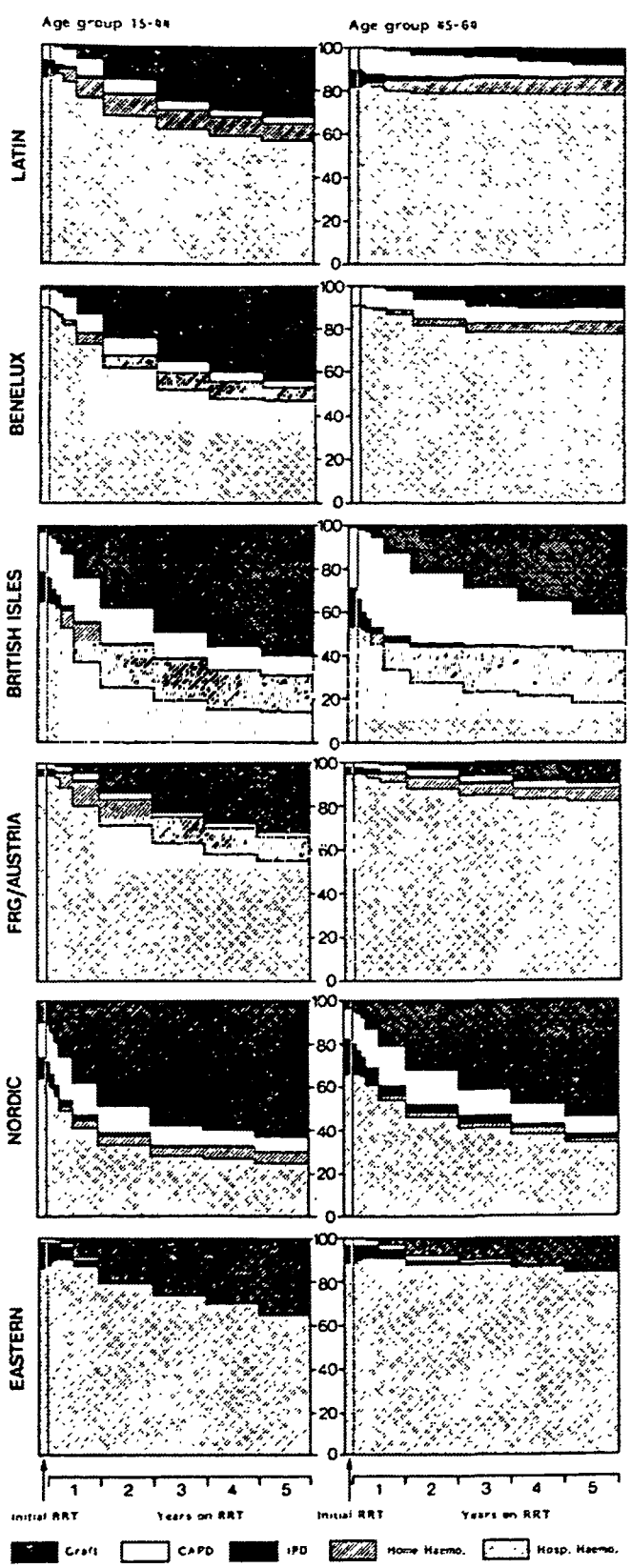

Fig. 4. Proportional contribution of different forms of renal replacement therapy at intervals after the date of starting renal replacement therapy in patients commencing treatment 1980–1984, shown according to age group. Geographical regions are defined in Table 2.

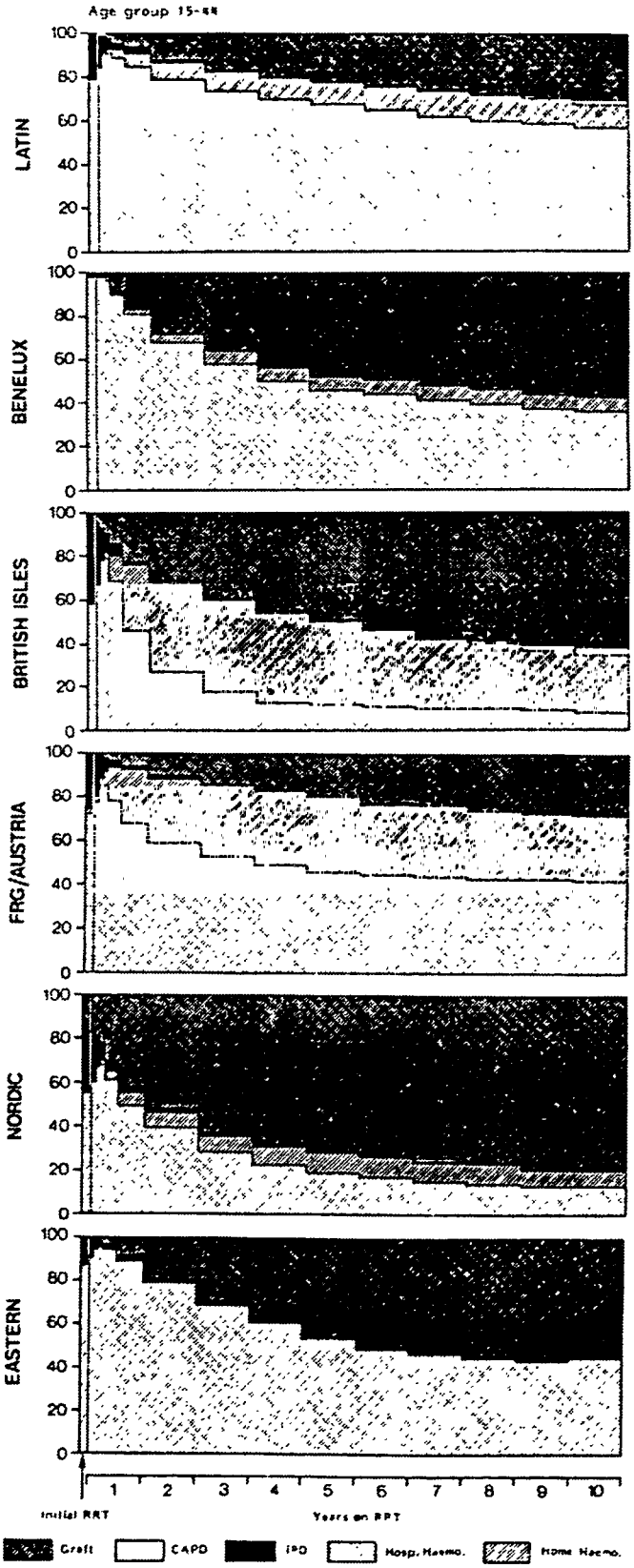

Fig. 5. Proportional contribution of different forms of renal replacement therapy at intervals after the date of starting renal replacement therapy in patients commencing treatment 1970–1974, age group 15–44 years. Geographical regions are defined in Table 2.

any one year after start of renal replacement therapy who died) on specific treatment modalities. These differences appear to have resulted from differing treatment policies. The trend in the British Isles to move patients on to home haemodialysis might have generated a greater number of high-risk home-dialysis patients and thus perhaps explain the higher mortality rates in British patients as compared to residents of Latin countries. The high transplantation rates in Nordic countries can be assumed to have decreased rapidly the number of healthy long-term dialysis patients and generated a sizeable number of transplant failures who were at increased risk of dying whilst back on dialysis. The Nordic population on any form of dialysis during the third to fifth year of renal replacement therapy would thus in no way be comparable to the dialysis populations in the Federal Republic of Germany, Austria and the Latin countries.

In the course of the years, the annual death rates in patients on hospital haemodialysis changed little, and the variability in death rates on continuous peritoneal dialysis showed no regular trends. Death rates with a functioning graft were definitely at their peak during the first year of this therapy, when all grafted patients go through the early high-risk post-transplant period. Thereafter, during the second to fifth year of renal replacement therapy, death rates with a functioning graft were consistently low because patients going through the early post-transplant period after a first graft or regraft were outnumbered by far by recipients of a graft that had been functioning for a few months or longer. It should be kept in mind that complications acquired with a failing graft may ultimately cause death weeks or months later, which appear as deaths on dialysis in this type of analysis.

Survival According to Primary Renal Disease

Systemic diseases, including diabetic nephropathy, primary hypertension and malignancies which cause end-stage renal failure, increase the risk of dying in comparison to the common primary renal diseases [4–9]. Separate survival rates were, therefore, calculated for patients with so-called standard primary renal diseases (chronic renal failure of uncertain aetiology, chronic glomerulonephritis, chronic pyelonephritis/interstitial nephritis, toxic nephropathies, polycystic kidney diseases), for patients with diabetic nephropathy, and for those with all other diseases including lupus erythematosus, myeloma, renal vascular diseases, etc. Mortality was confirmed to be higher in patients with systemic diseases (Table 3). This was particularly obvious in young patients with diabetes mellitus

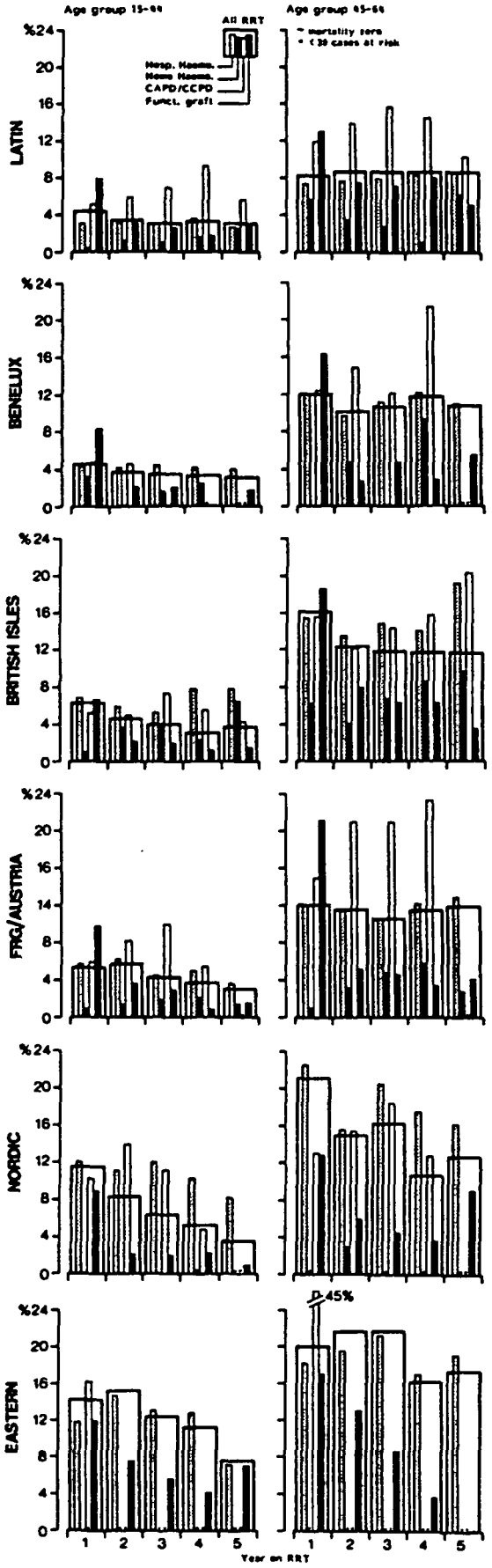

Fig. 6. Per cent mortality in each of the first 5 years of renal replacement therapy according to method of renal replacement therapy 1980–1985, shown according to age group. Geographical regions are defined in Table 2.

Table 3. Patient survival after first renal replacement therapy (RRT) 1980–1984 with standard primary renal disease (PRD) (which includes chronic renal failure aetiology uncertain, glomerulonephritis, pyelonephritis/interstitial nephritis, nephropathy caused by drugs or toxic agents and cystic kidney diseases), with diabetic nephropathy and with other primary renal diseases

Age at first RRT (years)	Standard PRD			Diabetic nephropathy			Other PRD		
	n	% Survival		*n*	% Survival		*n*	% Survival	
		2 yr	5 yr		2 yr	5 yr		2 yr	5 yr
0–14	1 505	90	83	*	*	*	818	88	82
15–44	24 977	89	79	2 678	66	44	5 700	86	75
45–64	31 027	82	60	3 739	57	25	8 344	72	49
≥65	11 141	65	34	1 240	42	13	3 526	55	26

An asterisk (*) denotes less than 30 patients at risk

who succumbed at three times the rate of their counterparts with standard primary renal diseases (Fig. 7).

From this analysis of survival according to primary renal disease emerges an explanation for the lower overall survival figures obtained in Nordic countries particularly in the 15–44-year-old cohort. There, only 53% of patients had standard primary renal diseases against almost 40% with diabetic nephropathy. As patient survival according to primary renal disease differed little between Western European regions both for standard primary renal disease and for diabetic nephropathy (Table 4), the lower overall survival results were mainly due to the high proportion of patients with diabetes mellitus among the uraemic population in Nordic countries.

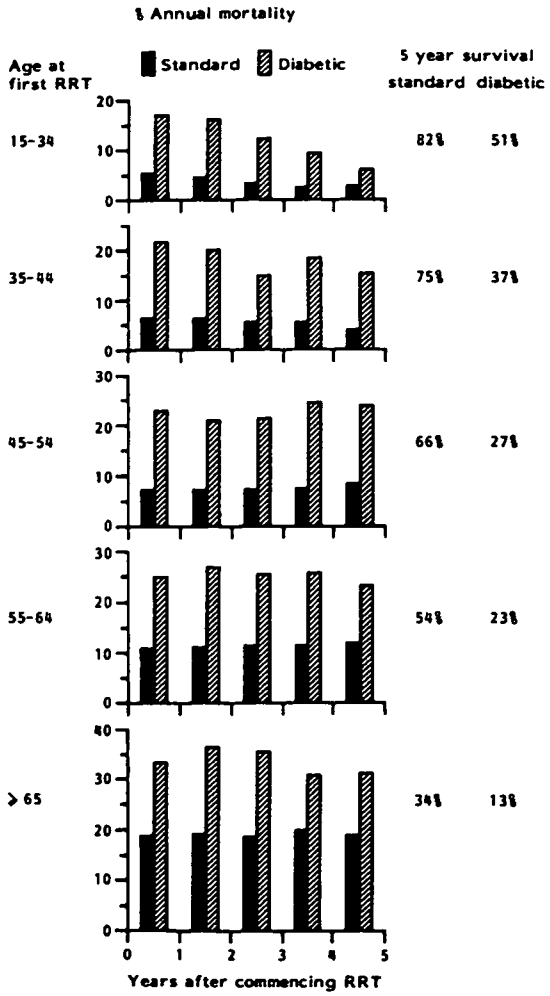

Fig. 7. Per cent annual mortality of patients with standard primary renal diseases compared to diabetics, shown according to age at first renal replacement therapy (RRT). Per cent survival at 5 years is given for each of these groups. Standard primary renal diseases are defined in Table 3.

Survival on Haemodialysis/Haemofiltration

In the section of the EDTA patient questionnaire which relates to treatment sequence and which is used for survival calculations, no distinction has been made between various methods of extracorporeal blood purification. We know, however, that a minority of patients have undergone haemofiltration, haemodiafiltration, or haemodialysis combined with haemoperfusion [10] and not infrequently have been changed from one of these methods to another. The majority have been treated with haemodialysis, which continues to be the most widely used mode of renal replacement therapy all over the world with the exception of the Nordic and British groups of countries, where the numbers of patients with functioning grafts exceed those on haemodialysis [10].

The figures presented in Table 5 show survival from the start of renal replacement therapy with haemodialysis/haemofiltration. The end point of the calculation was either the date of death or the date of change to another treatment mode, i.e. peritoneal dialysis or transplantation. A change from centre to home haemodialysis/haemofiltration was disregarded, since home treatment is not performed in some countries, and only available to a small group of more or less selected patients in many other countries. With the majority of patients with end-stage

Table 4. Patient survival after first renal replacement therapy in 1980–1984 for patients with standard primary renal diseases (PRD) and with diabetic nephropathy. Results are shown according to geographical region

Geographical region	Standard PRD Age group						Diabetic nephropathy Age group					
	15–44			45–64			15–44			45–64		
	n	% Survival		*n*	% Survival		*n*	% Survival		*n*	% Survival	
		2 yr	5 yr		2 yr	5 yr		2 yr	5 yr		2 yr	5 yr
Latin	8 617	95	89	11 827	87	69	634	68	41	1423	63	30
Benelux	1 190	95	88	1 729	85	64	147	75	*	208	52	*
FRG/Austria	4 225	92	84	7 311	82	60	567	66	46	1114	57	24
British Isles	2 640	93	84	2 574	77	56	346	70	47	296	57	*
Nordic	859	93	85	1 472	74	52	617	66	48	261	45	*
Eastern	3 443	74	54	2 114	65	36	138	38	*	100	30	*

An asterisk (*) denotes less than 30 patients at risk
Standard primary renal diseases are defined in Table 3
Geographical regions are defined in Table 2

Table 5. Patient survival on first haemodialysis (including home haemodialysis and haemofiltration) according to age at start of treatment. Results are given according to year of first renal replacement therapy (RRT)

Age at first RRT (years)	Year of first renal replacement therapy												
	1980–1984						1970–1974						
	n	% Survival					*n*	% Survival					
		1 yr	2 yr	3 yr	4 yr	5 yr		2 yr	4 yr	6 yr	8 yr	10 yr	12 yr	15 yr
0–14	1 894	95	91	89	86	82	733	79	73	65	62	60	59	*
15–34	16 858	94	89	85	82	80	9 060	81	72	66	62	58	55	51
35–44	13 252	92	86	80	75	71	6 843	77	64	56	49	45	39	31
45–54	19 507	91	83	76	70	63	6 907	75	59	47	38	31	25	17
55–64	18 919	88	77	69	60	53	3 099	68	46	32	23	15	10	*
≥65	13 217	81	65	53	43	35	549	59	35	21	12	7	*	*

Number of patients at risk at time zero (*n*) is shown. An asterisk (*) denotes less than 30 patients at risk

renal disease receiving treatment by haemodialysis, it is not surprising that survival figures for any age group and at any point in time closely resemble those obtained for all forms of renal replacement therapy combined, shown in Table 1.

Figure 8 shows the lower survival rates on haemodialysis for patients with diabetic nephropathy as compared to patients with standard primary renal diseases. The difference in survival is entirely comparable to that shown for patients on renal replacement therapy in Fig. 7 or Table 3.

Lower survival rates resulting from higher annual mortality of 12.7% for 20–44-year-old and 34% in over 65-year-old patients on dialysis were reported from the United States for patients starting dialysis in 1977 [9]. Apart from the acceptance of more high-risk patients in the United States, this difference in the calculated survival

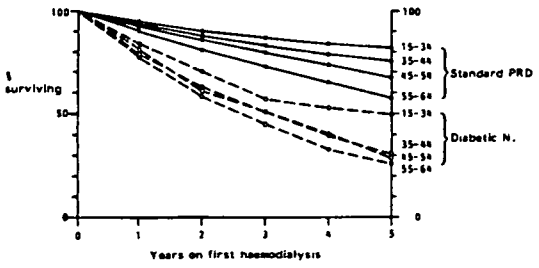

Fig. 8. Patient survival on first haemodialysis 1980–1984, standard primary renal diseases (PRD) compared to diabetic nephropathy. Standard primary renal diseases are defined in Table 3.

rates might be explained by the fact that patients who had received transplants were excluded from the analysis. This effectively removed from the analysis a part of the patient population, particularly in the younger age groups, which

was surviving at least up to the moment of transplantation. The number of patients surviving on dialysis was thereby reduced, whilst all the deaths on dialysis were included. The European survival rates for patients on haemodialysis should, therefore, not be weighed against these American figures.

Survival on Continuous Peritoneal Dialysis (CAPD/CCPD)

Continuous peritoneal dialysis as a distinct entity was introduced as one of five methods of treatment on the EDTA Registry patient questionnaire in 1981. Accordingly, patient survival on continuous peritoneal dialysis is shown for patients starting treatment in 1981–1984 (Table 6). The survival rates do not differ appreciably from those obtained for patients on all forms of renal replacement therapy shown in Table 1. For several reasons these figures should not be compared to those of patients on haemodialysis. Selection of patients for either haemodialysis or CAPD is unlikely to have occurred in a randomised fashion. Local preference, availability of facilities, anticipated complications with vascular access, or diabetes mellitus may have determined whether a patient was started on CAPD rather than on haemodialysis. Conditions which might have been associated with definite differences in mortality were thus likely to show an uneven distribution between patients on CAPD as compared to haemodialysis. In fact, a much higher proportion of patients with diabetes mellitus was treated with CAPD, and the difference in survival on CAPD compared to that of patients with standard primary renal diseases (Fig. 9) was almost as striking as shown in Table 3 for any type of renal replacement therapy. Thus, taking primary renal disease into account, survival achieved by CAPD was certainly no lower, and possibly even better, than with other modes of treatment.

Table 6. Patient survival on first CAPD/CCPD. Results are shown according to age at start of renal replacement therapy in 1981–1984

Age at first RRT (years)	*n*	% Survival			
		1 yr	2 yr	3 yr	4 yr
0–14	452	95	90	90	*
15–44	3082	94	88	82	74
45–64	5399	87	74	63	54
⩾65	2403	77	57	42	30

An asterisk (*) denotes less than 30 patients at risk

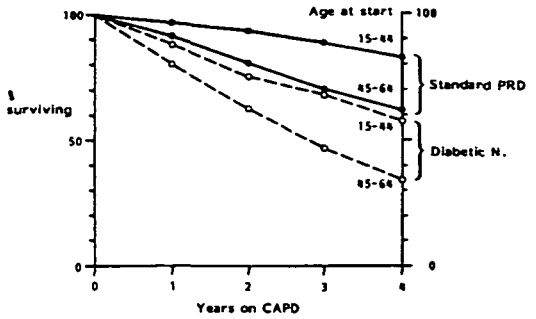

Fig. 9. Patient survival on first CAPD 1981–1984, standard primary renal diseases (PRD) compared with diabetic nephropathy. Standard primary renal diseases are defined in Table 3.

Survival After Renal Transplantation

Patient and Graft Survival After First Cadaveric Graft

The improvement in patient and graft survival rates between the early seventies and the eighties is particularly striking for cadaveric transplantation (Tables 7, 8). This is not only due to the tremendous decline in the risk of dying during the early postoperative period, but also results from a lower interval mortality at any time after the first few post-transplant months a decade later. Figure 10 shows annual mortality after grafting, which was higher during the first year and then decreased to below 3% interval mortality in the 15–44-year-old recipients, and to some 6% in the 45–64-year-old cohort. This mortality involves all deaths, including also those occurring at any time after first graft failure. Taking all these deaths into account, patient survival rates in all age groups have, nevertheless, risen above those of the dialysis population as a whole. Several explanations are possible. Some lethal complications encountered in dialysed patients might no longer occur with a successful transplant, or transplantation might be performed in a physically fitter dialysis population that would have better survival despite transplantation. Whatever the explanation, it seems no longer true that the prospect of a better quality of life with a functioning transplant has to be balanced against a markedly increased risk of an early death after transplantation.

Two different ways of computing and depicting survival in transplantation are demonstrated in Fig. 11. The upper curve shows survival *with* a graft, i.e. only those deaths occurring whilst the graft was still functioning were considered, and all patients who survived graft failure were treated as lost to follow-up at the moment when they moved to any other mode of renal replacement therapy (or were regrafted). Interval mortalities were lower using this method for computing survival, despite the fact that the number of patients at risk becomes smaller at each interval. However, increased mortality after graft failure or during the early post-transplant period of repeated

Table 7. Patient survival after cadaver first graft, shown according to age at grafting and year of grafting

Age at grafting (years)	Year of cadaver first graft												
	1980–1984						1970–1974						
	n	% Survival					*n*	% Survival					
		1 yr	2 yr	3 yr	4 yr	5 yr		2 yr	4 yr	6 yr	8 yr	10 yr	12 yr	15 yr
0–4	911	93	91	90	88	86	191	79	71	64	59	57	54	*
15–44	12 794	93	91	88	86	83	4 396	72	64	58	53	49	45	39
45–64	6 161	86	81	77	71	67	1 837	55	45	37	30	24	21	15
≥65	173	78	71	66	58	53	7	*	*	*	*	*	*	*

An asterisk (*) denotes less than 30 patients at risk

Table 8. Survival of cadaver first grafts, shown according to age of recipient and year of grafting

Age at grafting (years)	Year of cadaver first graft												
	1980–1984						1970–1974						
	n	% Graft survival					*n*	% Graft survival					
		1 yr	2 yr	3 yr	4 yr	5 yr		2 yr	4 yr	6 yr	8 yr	10 yr	12 yr	15 yr
0–14	908	69	60	54	50	44	189	56	48	41	35	29	25	*
15–44	12 761	69	63	58	54	51	4 385	47	40	34	31	27	24	20
45–64	6 150	67	61	56	50	46	1 837	39	31	26	22	18	15	11
≥65	173	63	58	54	46	*	7	*	*	*	*	*	*	*

An asterisk (*) denotes less than 30 patients at risk

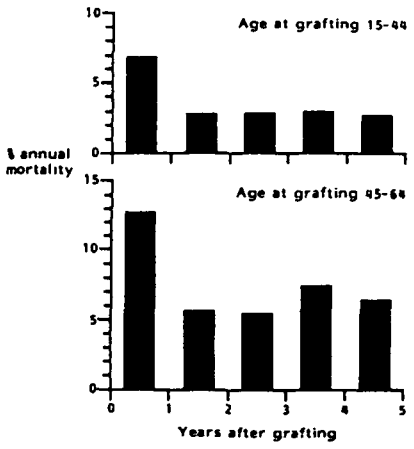

Fig. 10. Annual mortality after first cadaver graft 1980–1984, according to age at grafting.

grafting is not considered. The survival curve, therefore, has a 'better' appearance. The EDTA Registry has usually shown survival *after* grafting by considering all deaths occurring at any time after the event of transplantation [11]. This is depicted by the lower curve in Fig. 11, and as shown in this paper in all the Tables on patient survival after grafting.

The age dependence of survival on renal replacement therapy in general was also apparent in patient and graft survival for cadaveric transplantation performed in 1970–1974. A decade later, patient survival continued to be better in the younger compared to the older graft recipients, but the difference was less marked. Low mortality, particularly in cadaveric graft recipients older than 65 at grafting might be explained by more careful selection of low-risk candidates for transplantation in older patient groups. This may also explain why the impact of age on the first cadaveric *graft* survival was almost completely lost in 1980–1984. In contrast, more high-risk (including increasingly younger) paediatric patients have received grafts in more recent years. Graft survival has thus improved in all paediatric age groups, but the rising proportion of high-risk paediatric recipients aged 0–4 and 5–9 years (Fig. 12) has resulted in almost unchanged average graft survival rates for the paediatric population as a whole.

Patients with diabetic nephropathy had lower graft survival as shown in Fig. 13. The obvious reason for lower

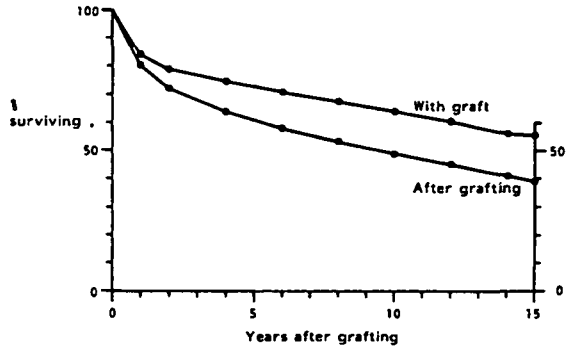

Fig. 11. Per cent patient survival, cadaver first graft 1970–1974 and age at grafting 15–44 years.

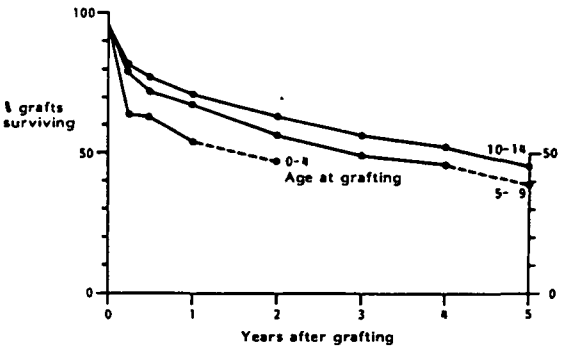

Fig. 12. Per cent cadaver first graft survival in paediatric patients 1980–1984, according to recipient age at grafting.

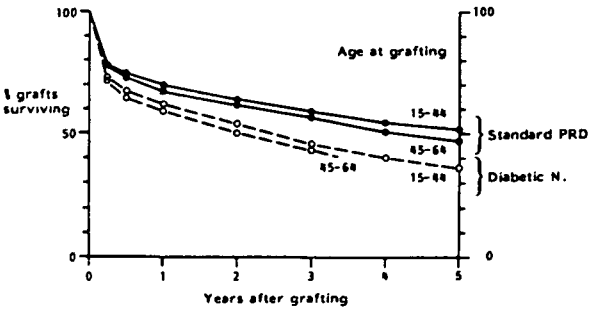

Fig. 13. Per cent first cadaver graft survival 1980–1984 according to recipient age at grafting, standard primary renal diseases (PRD) compared to diabetic nephropathy. Standard primary renal diseases are defined in Table 3.

graft survival was the markedly higher rate of death with a functioning graft which restricted survival at 5 years to 54% in the 15–44-year-old diabetic nephropathy recipients (Fig. 14).

Patient and Graft Survival After Living Related Donor First Transplantation

Tables 9 and 10 show results obtained in patients with living related donor first grafts. The exact genetic relationship was not recorded in the early seventies but, in 1980–

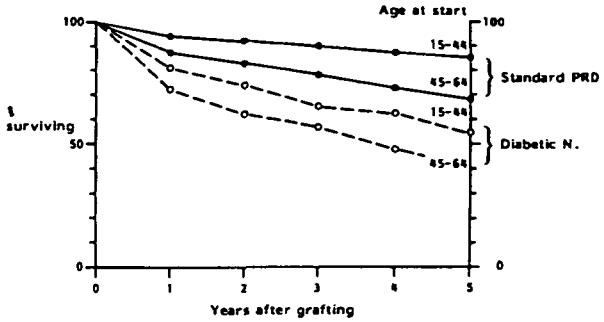

Fig. 14. Per cent patient survival after first cadaver transplant 1980–1984 according to age at start of treatment, standard primary renal diseases (PRD) compared to diabetic nephropathy. Standard primary renal diseases are defined in Table 3.

1984, the percentage of HLA-identical sibling grafts was 29%, of haploidentical sibling grafts 11%, and of parental grafts 58% (Table 11). Non-identical sibling grafts were used rarely (1%) and genetic relationship of sibling graft donor to recipient was recorded as unknown in 1% of cases. The great majority of paediatric recipients received parental grafts, whereas almost half of the recipients aged over 45 at grafting received identical sibling grafts. Both patient and graft survival rates were superior to those obtained in cadaveric transplantation and improved during the last decade. Graft survival of haploidentical sibling and parental grafts were similar and, as was to be expected, was inferior to the graft survival of identical sibling grafts (Fig. 15).

Regraft Survival

Selection of patients by age at regrafting can be problematical with the current analytical software available for the EDTA computer. For this reason, and in order to obtain a sample of patients comparable to recipients of first grafts, age groups for second cadaveric transplantation were formed by using the year of birth. Similarly to first transplantation, results of graft and patient survival after second cadaveric transplantation have markedly improved within the last decade. The living donor second graft survival rate was much better than that obtained for cadaveric second grafts and did not differ from the living donor first graft survival rate (Tables 12 and 13).

Second cadaveric graft survival for patients aged 15–44 years at regrafting was also computed according to the fate of the first graft. One group was selected because the first graft had been lost within 6 months due to rejection, the other group because of a first-graft survival of over one year. The difference in second cadaveric graft survival between these two groups is striking. In those patients whose first graft had been functioning for more than one year, second graft survival was superior even to average first graft survival (Fig. 16). As many as 9% of second grafts in patients who had rejected the first graft within 6

Table 9. Patient survival after live related donor first graft, shown according to age of recipient and year of grafting

Age at grafting (years)	Year of live related donor first graft												
	1980–1984						1970–1974						
	n	% Survival					*n*	% Survival					
		1 yr	2 yr	3 yr	4 yr	5 yr		2 yr	4 yr	6 yr	8 yr	10 yr	12 yr	15 yr
0–14	268	95	95	94	92	92	77	92	82	75	71	69	69	*
15–44	1913	95	93	91	89	87	766	85	78	72	68	65	62	56
≥45	229	88	83	78	72	72	88	81	64	62	53	47	45	*

An asterisk (*) denotes less than 30 patients at risk

Table 10. Survival of live related donor first grafts according to age of recipient and year of grafting

Age at grafting (years)	Year of live related donor first graft												
	1980–1984						1970–1974						
	n	% Graft survival					*n*	% Graft survival					
		1 yr	2 yr	3 yr	4 yr	5 yr		2 yr	4 yr	6 yr	8 yr	10 yr	12 yr	15 yr
0–14	268	83	78	71	63	61	77	74	58	44	39	*	*	*
15–44	1912	82	77	74	70	66	766	70	63	56	52	49	43	37
≥45	229	77	72	67	62	60	85	66	56	55	46	39	*	*

An asterisk (*) denotes less than 30 patients at risk

Table 11. Source of living related donor first graft 1980–1984

Age at grafting (years)	Per cent			
	Parent	Sibling		
		ident	haplo	non/?
0–14	94	5	1	0
15–44	58	29	10	3
≥45	20	53	25	2
All	58	29	11	2

Ident = HLA identical sibling graft; haplo = haploidentical sibling graft; non/? = non-identical sibling graft, or genetic relationship of sibling graft donor to recipient recorded as unknown

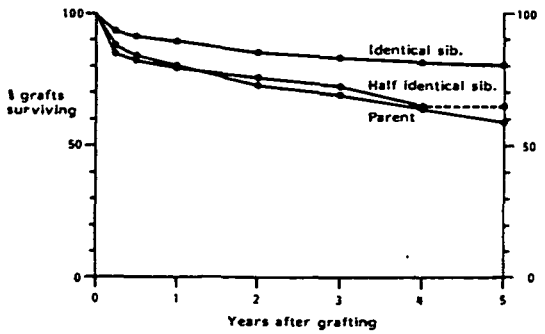

Fig. 15. Per cent live related donor first graft survival 1980–1984 for sibling and parental grafts, recipient age at grafting 15–44 years.

months never functioned, and another 27% failed within 3 months. Thereafter, no difference could be detected in the interval graft failure rates of the two groups, which was also similar to the interval failure rate of first grafts. Rapid rejectors of a first graft thus appear to lose second or subsequent grafts at a much higher rate. This same reason may explain the restricted survival of third cadaveric grafts, which nevertheless has improved in recent years (Table 14). A sizeable proportion of third cadaveric grafts never functioned, i.e. 10% of third grafts as compared to 6% on average of second grafts and 3% of first grafts performed in 1980–1984. Only 58% of third grafts functioned up to three months, although interval graft failure rates thereafter did not appear to differ from those of first or second cadaveric grafts.

Conclusions

Despite differing treatment strategies, survival rates all over Europe were found to be similar. Transplantation has been used preferentially and for all age groups in Nordic countries, hospital or centre dialysis was the salient mode of treatment in Latin countries, and both home haemodialysis and CAPD were prominently applied in the British Isles. Survival rates improved between the seventies and the early eighties, and this was particularly

Table 12. Patient survival after second graft according to year of grafting. Results are shown separately for patients with cadaver grafts according to age at grafting and with living related donor grafts

Source of second graft	Age at grafting (years)	Year of second grafting: 1980–1984							1970–1974						
		n	(Year of birth)	% Survival					*n*	(Year of birth)	% Survival				
				1 yr	2 yr	3 yr	4 yr	5 yr			1 yr	2 yr	3 yr	5 yr	8 yr	10 yr
Cadaver	0–19	205	(≥1965)	95	94	92	88	*	37	(≥1955)	81	78	*	*	*	*
	15–44	1 504	(1940–64)	94	91	89	87	85	518	(1930–54)	77	71	66	57	49	45
	≥45	458	(<1935)	84	76	70	65	61	152	(<1925)	63	49	43	30	20	*
Living donor	All	139	(any)	96	90	88	88	*	25	(any)	*	*	*	*	*	*

An asterisk (*) denotes less than 30 patients at risk

Table 13. Survival of second grafts according to year of grafting. Results are shown separately for cadaver grafts according to age at grafting and for living related donor grafts

Source of second graft	Age at grafting (years)	Year of second grafting: 1980–1984							1970–1974						
		n	(Year of birth)	% Graft Survival					*n*	(Year of birth)	% Graft Survival				
				1 yr	2 yr	3 yr	4 yr	5 yr			1 yr	2 yr	3 yr	5 yr	8 yr	10 yr
Cadaver	0–19	205	(≥1965)	68	62	51	*	*	37	(≥1955)	43	*	*	*	*	*
	15–44	1 495	(1940–64)	65	59	54	50	47	516	(1930–54)	49	41	38	31	24	20
	≥45	457	(<1935)	54	46	41	37	*	152	(<1925)	45	35	28	22	14	*
Living donor	All	139	(any)	82	76	75	75	*	25	(any)	*	*	*	*	*	*

An asterisk (*) denotes less than 30 patients at risk

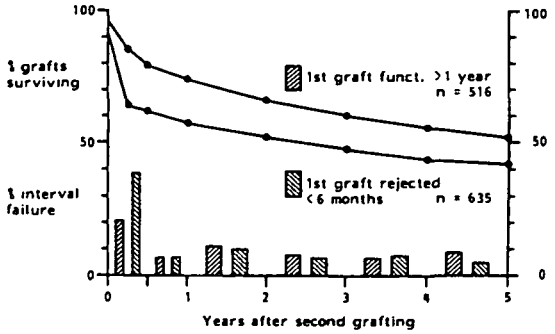

Fig. 16. Per cent second cadaver graft survival and interval failure 1980–1984. recipient age group 15–44 years and year of birth 1940–1964.

striking in transplantation. Some differences in patient survival between geographical regions might be attributed to differing treatment policies. The early post-transplant period still carries an increased risk of dying, although this has been reduced with grafts performed in recent years. The high rate of transplantation early in the course of renal replacement therapy in Nordic countries is, therefore, associated with slightly lower survival of the uraemic population during the early phase of treatment. However, the most important explanation for the higher overall mortality in Nordic as compared to Latin countries is given by the large proportion of Nordic patients with diabetic nephropathy who, particularly in the younger age groups, succumbed at a markedly higher rate than their non-diabetic counterparts.

Because of differing treatment policies or differing reasons for preferentially selecting one or another method of renal replacement therapy, one should not compare survival or mortality on different treatment modalities. All methods have their virtues and their disadvantages and may contribute equally to the survival of the uraemic population as demonstrated in the various tables shown in this paper.

Patients on renal replacement therapy are still far from approaching the survival rates of the general population which has a mortality of less than 1% annually below the age of 65 in females and 55 in males. Nevertheless, survival rates have improved in the course of the last decade and can be expected to exceed 65% for young adults and 25% for patients aged 55–64 years at 10 years after starting renal replacement therapy in the early eighties.

Table 14. Survival of cadaver third grafts according to year of grafting

Year of grafting								
1980–1984						1970–1974		
n	% Graft survival					*n*	% Graft survival	
	1 yr	2 yr	3 yr	4 yr	5 yr		1 yr	2 yr
285	52	47	39	35	*	71	41	*

An asterisk (*) denotes less than 30 patients at risk

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