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An Overview of Regular Dialysis Treatment in Japan as of 31 December 2003

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Abstract: A statistical survey of 3750 nationwide dialysis facilities was carried out by the Japanese Society for Dialysis Therapy (JSDT) at the end of 2003, with answers to the questionnaires received from 3717 facilities (99.12%). The population of dialysis patients in Japan at the end of 2003 was 237,710, and the number of dialysis patients per million people was 1862.7. The crude death rate during a 1-year period from the end of 2002 to the end of 2003 was 9.3%. The mean age of patients newly introduced to dialysis was 65.4 years, and the mean age of the entire dialysis population was 62.3 years. The primary diseases in the patients newly introduced to dialysis in 2003 included diabetic nephropathy (41.0% of patients) and chronic glomerulonephritis (29.1% of patients). The mean serum neutral fat concentration for all the dialysis patients was 113.9 ± 71.7 mg/dL (± SD). The mean serum low density lipoprotein (LDL)-cholesterol concentration was 90.8 ± 30.9 mg/dL. Dialysate calcium concentrations ranging from 3.0 mEq/L to less than 3.5 mEq/L were used for majority of the dialysis patients (55.4%). Among anticoagulants given to the dialysis patients, heparins were the most commonly used in 79.3% of the dialysis patients. The relationship between blood pressure during dialysis and life expectancy for 1 year was analyzed for 43 465 patients who had undergone dialysis three times per week at the end of 2001. Results showed a significantly high mortality risk for patients who had systolic blood pressure of less than 100 mm Hg at the start of dialysis, systolic blood pressure of less than 100 mm Hg at the end of dialysis, and the greatest decrease (lowest) in systolic blood pressure of less than 120 mm Hg during dialysis. Patients who received vasopressor therapy during dialysis had a higher mortality risk than those who received no vasopressor therapy. **Key Words:** Blood pressure, Dialysis, Mortality, Survey, Vasopressor.

The Japanese Society for Dialysis Therapy (JSDT) has carried out an annual statistical survey of dialysis facilities nationally since 1968. This report consists of two main parts. In the first half of the present report, a summary of the results of the survey carried out at the end of 2003 (referred to as 'A') is presented. In the second half, the results of the analysis of the relationship between blood pressure during hemodialysis (hereafter referred to as dialysis) and life expectancy (referred to as 'B') is presented.

The survey at the end of 2003 was carried out by sending questionnaires to 3750 facilities across the country, 3717 facilities (99.12%) responded. The findings of this survey are described in the first half of the present report.

The blood pressure of dialysis patients correlates closely to the life expectancy of patients. It was reported that both mortality rates of dialysis patients with low blood pressure and those with high blood pressure were high (1). However, there have been no studies analyzing the relationships between changes in blood pressure at the start and end of dialysis and life expectancy, in relation to vasopressor therapy carried out during dialysis, as indicated by our review of published work.

In the second half of this report, the relationship between blood pressure changes during dialysis and the life expectancy of patients was analyzed by considering the effect of vasopressor therapy given during dialysis. This analysis was carried out on the data

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of 43 465 dialysis patients extracted from the dialysis patient database of the Japanese Society for Dialysis Therapy. The following three analyses compose this report.

In the first analysis, we clarified the relationships between three types of systolic blood pressure (namely, systolic blood pressure at the start of dialysis, systolic blood pressure at the greatest decrease during dialysis treatment, and systolic blood pressure at the end of dialysis) and the life expectancy of patients. Furthermore, the relationship between vasopressor therapy carried out during dialysis and the life expectancy of patients was also clarified.

In the second analysis, the patients were classified into three groups according to systolic blood pressure at the greatest decrease during dialysis. Additionally, the relationship between vasopressor therapy and patients' life expectancy in these patient groups was clarified. The results of this analysis showed the possibility that vasopressor therapy given during dialysis increases the mortality risk in patients with the greatest decrease (lowest) in systolic blood pressure of less than 120 mm Hg during dialysis.

In the third analysis, we determined the relationship of vasopressor therapy during dialysis with systolic blood pressure at the end of dialysis, and life expectancy in only the patients with the greatest decrease (lowest) in systolic blood pressure of less than 120 mm Hg during dialysis.

MATERIALS AND METHODS—A. SURVEY AT THE END OF 2003

The present survey was carried out using questionnaires sent to individual dialysis facilities at the end of each year.

The Japanese Society for Dialysis Therapy assigns 66 people across Japan to collect information on facilities carrying out dialysis therapy in each prefecture. The present study was carried out on the basis of information collected from these dialysis facilities using the above procedure. Facilities which were not members of the Japanese Society for Dialysis Therapy were also included in the survey. The participants in the present study included all of the facilities which offer dialysis therapy in Japan at the time the survey was carried out. There were 3750 facilities offering dialysis therapy at the end of December 2003. The number of facilities in the present survey increased compared with the number in last year's survey by 125 (3.44%).

The questionnaires were mainly sent and collected by mail, although they were also faxed to some of the facilities. Facilities also had the option of completing the survey electronically, in these cases, floppy disks were sent via mail.

This survey was of two types. One was a facility survey and related to the details of dialysis facilities, such as the number of patients, the number of staff members and the number of dialyzers at individual facilities. The other was a patient survey in which the epidemiological background, treatment conditions and outcome information on individual dialysis patients were investigated.

The response rate for the survey at the end of 2003 was 99.12% (3717 facilities), and it was nearly equivalent to that for the 2002 survey of 99.60%. The number of facilities which returned no patient surveys was 87 (in the previous year it was 111). As a result, the facilities from which answers to both the facility and patient surveys were collected accounted for 96.80% of all the facilities.

Basic data concerning chronic dialysis patients at the end of 2003

Data concerning dialysis population dynamics for the year 2003 were obtained mainly on the basis of the results of the facility survey. These included the number of patients newly introduced to dialysis, the number of deceased patients in 2003, the total number of dialysis patients at the end of 2003, and the crude death rate in 2003.

The classification of the causes of death was changed from the conventional classification (Table 1) to the 10th modified edition of the International Classification of Diseases (ICD-10, Table 2) starting with the survey at the end of 2003.

In addition, the cumulative survival rate after the introduction of dialysis was actually calculated on the basis of the results of the patient survey (2).

Data for new survey items

Items investigated for the first time in this survey were serum neutral fat concentration, time from the meal taken before blood sampling to blood sampling, dialysate calcium concentration, and anticoagulant-use status. The results of summations for these items are described below.

The types of anticoagulant were investigated using the following choices.

A: Regular heparins (heparin Na or heparin Ca)
B: Low-molecular-weight heparins
C: Protease inhibitor, nafamostat mesilate
D: Antithrombin
E: Sodium citrate
Z: Others

TABLE 1. *Previous cause-of-death code*

Cause of death	Presence/absence of diagnostic confirmation on the basis of autopsy, diagnostic imaging, biochemical tests	
	Absent	Present
Pericarditis	010	011
Pulmonary edema/Congestive heart failure	020	021
Cardiomyopathy/Cardiac infarction	030	031
Other cardiac failures	050	051
Valvular disease	052	053
Hyperkalemia	060	061
Sudden death	070	071
Pulmonary thromboembolism/infarct	080	081
Cerebrovascular disorder	090	091
Cerebral infarction	092	093
Brain hemorrhage	094	095
Other cerebrovascular diseases	096	097
Dialytic encephalopathy	110	111
Gastrointestinal bleeding	120	121
Septicemia/Bacteremia	140	141
Pneumonia/Pulmonary suppuration	150	151
Acute pancreatitis	160	161
Peritonitis	190	191
Tuberculosis	200	201
Fulminant hepatitis	210	211
Hepatitis	220	221
Cirrhosis	230	231
Intestinal obstruction/Ischemic enteritis	240	241
Malignant tumor		
Digestive organs	250	251
Kidney/Urinary organs	260	261
Other internal organs	270	271
Cachexia	280	281
Uremia	290	291
Suicide	300	
Dialysis refusal	310	
Death by disaster/Death by accident	320	321
Undetermined	330	
Others	340	341

In this survey, total cholesterol, high density lipoprotein (HDL)-cholesterol and neutral fat concentrations were investigated. Low density lipoprotein (LDL)-cholesterol concentration was calculated from these values using Friedewald's formula for summation. However, patients showing neutral fat concentrations higher than 400 mg/dL and those showing negative calculation values were excluded from the summation.

MATERIALS AND METHODS—B. ANALYSES OF CHANGES IN BLOOD PRESSURE DURING DIALYSIS AND LIFE EXPECTANCY

These analyses were carried out using the survey data at the end of 2001 and the end of 2002 within the statistical survey data of the Japanese Society for Dialysis Therapy (3,4).

Changes in blood pressure during dialysis were observed more clearly for systolic blood pressure than for diastolic pressure and mean blood pressure. Hence, the relationship between systolic blood pressure and life expectancy was analyzed.

Analysis 1

Relationships of systolic blood pressures at the start of dialysis, at the greatest decrease, and at the end of dialysis with vasopressor therapy and life expectancy.

Summary

The relationships of systolic blood pressures at the start of dialysis, at the greatest decrease and at the end of dialysis with life expectancy were clarified. In addition, the relationship between vasopressor therapy and life expectancy was also analyzed.

TABLE 2. *New cause-of-death code*

Cause of death	ICD 10 code	Cause-of-death code Presence/absence of diagnostic confirmation: Absent	Present
Tuberculosis	(A15–A19)	010	011
Septicemia	(A40–A41)	020	021
Acute virus hepatitis	(B159, B161, B169, B17)	030	031
Fulminant viral hepatitis	(B150, B160, B162, K720)	040	041
Human immunodeficiency viral (HIV) disease	(B20–B24)	050	051
Other infectious diseases	(A00–A09, A20-39, A42–A99, B00–B09, B25–B99, G00–G09)	060	061
Malignant neoplasm of digestive system	(C00–C26)	070	071
Malignant neoplasm of respiratory system	(C30–C39)	080	081
Malignant neoplasm of bone and cartilage	(C40–C41)	090	091
Malignant neoplasm of skin and soft tissue	(C43–C49)	100	101
Malignant neoplasm of breast	(C50)	110	111
Malignant neoplasm of female sexual organ	(C51–C58)	120	121
Malignant neoplasm of kidney	(C64)	130	131
Malignant neoplasm of urinary tract and male sexual organ	(C60–C63, C65–C68)	140	141
Malignant neoplasm of eyes, brain, and central nervous system	(C69–C72)	150	151
Malignant neoplasm of internal gland	(C73–C75)	160	161
Malignant neoplasm of lymph and hematopoietic tissue	(C81–C96, D45–D47)	170	171
Other neoplasm and cachexia	(C76–C80, C97, D00–D44, D48)	180	181
Hyperkalemia	(E875)	190	191
Dementia (syndrome)	(F00–F024, F03)	200	201
Dialysis encephalopathy	(F028)	210	211
Ischemic heart disease	(I20–I25)	220	221
Lung embolism	(I26)	230	231
Pulmonary heart disease	(I27)	240	241
Pericarditis	(I30–I32)	250	251
Endocarditis and valvula disorder	(I33–I39)	260	261
Myocarditis	(I40–I41)	270	271
Cardiomyopathy	(I42–I43)	280	281
Conduction blockage	(I44–I45)	290	291
Cardiac arrest (sudden death)	(I46)	300	301
Arrhythmia	(I47–I49)	310	311
Cardiac failure	(I50)	320	321
Subarachnoid hemorrhage	(I60)	330	331
Intracerebral hemorrhage	(I61)	340	341
Cerebral infarction	(I63)	350	351
Other cerebrovascular diseases	(I62, I64–I69)	360	361
Influenza	(J10–J11)	370	371
Pneumonia	(J12–J18)	380	381
Lung edema	(J81)	390	391
Intestinal hematogenous disorder	(K55)	400	401
Ileus	(K56)	410	411
Peritonitis	(K65)	420	421
Hepatic fibrosis and cirrhosis	(K74)	430	431
Gallbladder and biliary tract diseases	(K80–K83)	440	441
Acute pancreatitis	(K85)	450	451
Gastrointestinal bleeding	(K92)	460	461
Uremia	(N180)	470	471
Suicide	(X60–X84)	480	481
Disaster and accidental death	(V01–X59, X85–Y36)	490	491
Undetermined	(R95–R99)	500	501
Refusal of treatment (dialysis refusal)	(Z531, Z532)	510	
Others	{B18–B19, D50–D89, E00–E874, E876–E90, F04–F99, G10–G99, H00, 95, I00–I15, I28, I51–I52, I70–I99, J00–J06, J20–J80, J82-99, K00–K52, K57–K63, K66–K71, K721–K73, K75–K77, K86–K87, K90–K91, K93, L00–L99, M00–M99, N00–N17, N188–N99, O00–O99, P00–P96, Q00–Q99, R00–R94, S00–S99, T00–T98}	520	521

Subjects

Information on patients who had undergone dialysis three times per week at the end of 2001 was extracted from the statistical survey data of the Japanese Society for Dialysis Therapy. Among these patients who gave valid answers to the following analysis items, 43 465 were enrolled in these analyses.

Analysis items

Life expectancy analysis was carried out for the following items:

- Sex, age, history of dialysis, primary disease, treatment method, and dialysis frequency
- Bodyweight loss rate (weight before dialysis–weight after dialysis) × 100÷weight after dialysis), Kt/V, serum albumin concentration, hematocrit before dialysis, and dose of erythropoietin
- Systolic blood pressure at the start of dialysis (hereafter referred to as blood pressure at the start)
- Systolic blood pressure when blood pressure decreased the most (hereafter referred to as blood pressure at the greatest decrease)
- Systolic blood pressure at the end of dialysis (hereafter referred to as blood pressure at the end)
- Treatment carried out to increase the decreased blood pressure during dialysis or to prevent blood pressure from decreasing during dialysis (hereafter referred to as vasopressor therapy)

Among the above-mentioned analysis items, Kt/V was calculated using the method of Shinzato *et al*. (5). The effect of Kt/V on the prognosis of patients who have a significant remaining renal function is different from that on the prognosis of patients who do not. In view of this, the subjects of this analysis were limited to patients who had been on dialysis for 2 years or more and whose remaining renal functions were considered nearly negligible. The patients' epidemiological background is shown in Table 3.

Prognostic follow-up

The patients' prognosis was followed for 1 year from the end of 2001, until the end of 2002. The end point of the prognostic follow-up was death caused by reasons other than refusal to undergo dialysis, suicide, accident and disaster.

The patients whose treatment had been changed from dialysis three times per week to other treatments by the end of 2002, patients whose where-

TABLE 3. *Epidemiological background of patients*

Factor (%)		Factor (%)		Factor (%)	
Total number of patients	43 465 (100.0%)	Serum albumin concentration		Blood pressure at the start of dialysis (mm Hg)	
Sex		<3.0	959 (2.2%)	<100	471 (1.1%)
Male	17 410 (40.1%)	3.0 < 3.5	5 015 (11.5%)	100 < 120	2 349 (5.4%)
Female	26 055 (59.9%)	3.5 < 4.0	19 607 (45.1%)	120 < 140	7 934 (18.3%)
Age (years)		4.0 < 4.5	15 236 (35.1%)	140 < 160	14 334 (33.0%)
0 < 30	560 (1.3%)	>4.5	2 648 (6.1%)	160 < 180	12 045 (27.7%)
30 < 45	3 747 (8.6%)	Mean ± s.d.	3.86 ± 0.44	>180	6 332 (14.6%)
45 < 60	14 931 (34.4%)	Hematocrit before dialysis (%)		Mean ± s.d.	154 ± 24
60 < 75	18 110 (41.7%)	<20	158 (0.4%)	Blood pressure at the greatest decrease (mm Hg)	
>75	6 117 (14.1%)	20 < 25	1 872 (4.3%)	<80	1 728 (4.0%)
Mean ± s.d.	60.8 ± 12.7	25 < 30	13 629 (31.4%)	80 < 100	5 450 (12.5%)
History of dialysis (years)		30 < 35	21 688 (49.9%)	100 < 120	11 805 (27.2%)
2 < 5	15 156 (34.9%)	35 < 40	5 223 (12.0%)	120 < 140	14 280 (32.9%)
5 < 10	14 826 (34.1%)	>40	895 (2.1%)	140 < 160	8 224 (18.9%)
10 < 15	6 879 (15.8%)	Mean ± s.d.	30.8 ± 3.9	160 < 180	1 787 (4.1%)
15 < 20	3 613 (8.3%)	Dose of erythropoietin (IU/week)		>180	191 (0.4%)
20 < 25	2 125 (4.9%)	None	8 420 (19.4%)	Mean ± s.d.	121 ± 23
>25	866 (2.0%)	1 < 1500	1 082 (2.5%)	Blood pressure at the end of dialysis (mm Hg)	
Mean ± s.d.	8.61 ± 6.00	1500 < 3000	6 315 (14.5%)	<100	2 310 (5.3%)
Original cause for starting dialysis		3000 < 4500	6 042 (13.9%)	100 < 120	7 029 (16.2%)
Nondiabetic	10 883 (25.0%)	4500 < 6000	9 071 (20.9%)	120 < 140	13 007 (29.9%)
Diabetic	32 582 (75.0%)	6000 < 9000	4 909 (11.3%)	140 < 160	12 712 (29.2%)
Percentage weight decrease		>9000	7 626 (17.5%)	160 < 180	6 460 (14.9%)
0 < 2	2 026 (4.7%)	Mean ± s.d.	3 954 ± 3106	>180	1 947 (4.5%)
2 < 4	11 525 (26.5%)	Kt/V for urea		Mean ± s.d.	137 ± 24
4 < 6	19 744 (45.4%)	<0.8	369 (0.8%)	Vasopressor treatment	
6 < 8	8 498 (19.6%)	0.8 < 1.0	1 953 (4.5%)	None	29 932 (68.9%)
8 < 10	1 406 (3.2%)	1.0 < 1.2	7 784 (17.9%)	Oral and intravenous	3 472 (8.0%)
>10	266 (0.6%)	1.2 < 1.4	13 483 (31.0%)	Capacity	7 762 (17.9%)
Mean ± s.d.	4.84 ± 1.78	1.4 < 1.6	11 105 (25.5%)	Combined use	2 299 (5.3%)
		1.6 < 1.8	5 857 (13.5%)		
		>1.8	2 914 (6.7%)		
		Mean ± s.d.	1.39 ± 0.27		

TABLE 4. *Outcome of the patients in the end of 2002*

Outcome	Number of patients (%)
Alive	37 705 (86.7%)
Dead	
Refusal of dialysis	6 (0.0%)
Accident	22 (0.1%)
Suicide	18 (0.0%)
Other	2 542 (5.8%)
Change of treatment	1 640 (3.8%)
Uncertain	1 532 (3.5%)
Total	43 465 (100.0%)

abouts had been unknown at the end of 2002, and patients who had died because of refusal to undergo dialysis, suicide and accident were analyzed as unknown cases. The outcomes of the patients analyzed at the end of 2002 are shown in Table 4.

Analysis methods

The relationships between blood pressure during dialysis and various vasopressor therapies and life expectancy were analyzed using Cox's proportional hazard model (6). SAS Version 9.1 (SAS Institute Inc., Cary, NC, USA) was used for analysis.

When the relationships of blood pressure with vasopressor therapies and life expectancy were analyzed, the effects of sex, age, years on dialysis, presence or absence of diabetes, bodyweight loss rate, Kt/V, serum albumin concentration, hematocrit before dialysis, and dose of erythropoietin on the patients' life expectancy were adjusted using the proportional hazard model.

Classification by analysis factors (independent variables)

Classification by prognosis analysis factors (independent variables) was carried out with patients classified by sex. Patient age was not subjected to stratification but treated as a continuous variable. The patients were classified by primary disease into two groups: diabetic patients and non-diabetic patients.

The patients were also classified into five to seven groups according to the years spent on dialysis, blood pressure at the start, blood pressure at the greatest decrease, blood pressure at the end, bodyweight loss rate, Kt/V, serum albumin concentration, hematocrit before dialysis, and dose of erythropoietin. The details of patient classification by the above criteria are shown in Table 3. Classification by vasopressor therapy is shown below.

Classification by vasopressor therapy

Vasopressor therapy was investigated using options shown in Table 5. The patients were classified into the following four groups on the basis of findings:

(1) No vasopressor therapy group
Applicable choice: Only A
The group which underwent no vasopressor therapy.

(2) Oral/intravenous group
Applicable choices: B, F and J
The group which received an oral vasopressor drug and/or an intravenous vasopressor drug. All the oral and intravenous vasopressor drugs marketed in Japan increase blood pressure through the stimulation of sympathetic nerve α and/or β receptors.

(3) Volume group
Applicable choices: C, D, E, K, L, N, and W
The group which received physiological salt solution, high-concentration NaCl solution and/or concentrated glycerin solution. The mode of action of these drugs is increasing the volume of circulating plasma. This group is hereafter referred to as the 'volume-type' group.

(4) Combined use group
Applicable choices: G, H, I, M, O, P, Q, R, S, T, U, V, X, Y, Z, and 4
The group which received concomitant oral/intravenous and volume-type vasopressor drugs.

The investigation choice '5 others' was excluded from the analysis items since it was considered impossible to classify. Table 3 shows the number of patients classified in the respective groups.

Basic risk factors and life expectancy

Table 6 shows the relationships between basic risk factors used for correction and life expectancy. Significantly high mortality risks were observed in patients with the following characteristics: males, elderly, long history of dialysis, diabetes, bodyweight loss rates of less than 2% and more than 4%, serum albumin concentration of less than 4 g/dL, a hematocrit before dialysis of less than 25%, an erythropoietin dose of more than 9000 U/week, and a Kt/*V*-value for urea of less than 1.6.

Analysis 2: Relationships between vasopressor therapies and life expectancy with respect to blood pressure at the greatest decrease

Objective

The results of analysis 1 showed a high mortality risk for patients who underwent vasopressor therapy during dialysis. A high mortality risk was also observed in patients who exhibited systolic blood

TABLE 5. *List of vasopressor treatments—vasopressor treatment during dialysis*

A: None
B: Oral vasopressor
C: Physiological salt solution (or extracellular-fluid-type intravenous drip solution)
D: High-concentration NaCl solution
E: High-concentration glycerin solution (Griseol and Grenol)
F: Intravenous vasopressor

Combined use of two types of the above, B–F
G: Combined use of oral vasopressor and physiological salt solution (or extracellular-fluid-type intravenous drip solution)
H: Combined use of oral vasopressor and high-concentration NaCl solution
I: Combined use of oral vasopressor and high-concentration glycerin solution (Griseol and Grenol)
J: Combined use of oral vasopressor and intravenous vasopressor
K: Combined use of physiological salt solution (or extracellular-fluid-type intravenous drip solution) and high-concentration NaCl solution
L: Combined use of physiological salt solution (or extracellular-fluid-type intravenous drip solution) and high-concentration glycerin solution (Griseol and Grenol)
M: Combined use of physiological salt solution (or extracellular-fluid-type intravenous drip solution) and intravenous vasopressor
N: Combined use of high-concentration NaCl solution and high-concentration glycerin solution (Griseol and Grenol)
O: Combined use of high-concentration NaCl solution and intravenous vasopressor
P: Combined use of high-concentration glycerin solution (Griseol and Grenol) and intravenous vasopressor

Combined use of three types of the above, B–F
Q: Combined use of oral vasopressor, physiological salt solution (or extracellular-fluid-type intravenous drip solution) and high-concentration NaCl solution
R: Combined use of oral vasopressor, physiological salt solution (or extracellular-fluid-type intravenous drip solution) and high-concentration glycerin solution (Griseol and Grenol)
S: Combined use of oral vasopressor, physiological salt solution (or extracellular-fluid-type intravenous drip solution) and intravenous vasopressor
T: Combined use of oral vasopressor, high-concentration NaCl solution and high-concentration glycerin solution (Griseol and Grenol)
U: Combined use of oral vasopressor, high-concentration NaCl solution and intravenous vasopressor
V: Combined use of oral vasopressor, high-concentration glycerin solution (Griseol and Grenol) and intravenous vasopressor
W: Combined use of physiological salt solution (or extracellular-fluid-type intravenous drip solution), high-concentration NaCl solution and high-concentration glycerin solution (Griseol and Grenol)
X: Combined use of physiological salt solution (or extracellular-fluid-type intravenous drip solution), high-concentration NaCl solution and intravenous vasopressor
Y: Combined use of physiological salt solution (or extracellular-fluid-type intravenous drip solution), high-concentration glycerin solution (Griseol and Grenol) and intravenous vasopressor
Z: Combined use of high-concentration NaCl solution, high-concentration glycerin solution (Griseol and Grenol) and intravenous vasopressor

4: Combined use of four types or more of the above, B–F Others
5: Vasopressor treatment (not included in B–Z and 4 in the above)

pressure of less than 120 mm Hg during dialysis. Thus, the high mortality risk in the patients who underwent vasopressor therapy might be attributable to the decreased systolic blood pressure in these patients.

The patients were classified by blood pressure at the greatest decrease into three groups. The relationship between vasopressor therapy and mortality risk was determined for these three groups. The conditions related to blood pressure at the greatest decrease were nearly the same among the patient groups. Hence, if mortality risk during dialysis was attributed to the blood pressure at the greatest decrease, the mortality risk of vasopressor therapy calculated by this analysis should be lower than the mortality risk calculated for all the patients.

Subjects

The subjects of this analysis were the same as those (43 465) subjected to analysis 1.

The results of analysis 1 showed a high mortality risk for patients with blood pressure of less than 120 mm Hg at the greatest decrease and for those with blood pressure of 160 mm Hg or higher at the greatest decrease. Hence, in analysis 2, the patients were classified into three groups, namely, patients with blood pressure of less than 120 mm Hg at the greatest decrease, patients with blood pressure from 120 mm Hg to 160 mm Hg at the greatest decrease, and patients with blood pressure of more than 160 mm Hg at the greatest decrease. The relationship between vasopressor therapy and mortality risk was determined for each group. The background factors of these patient groups are shown in Table 7.

Analysis methods

The analysis method used was the same as that for analysis 1. The risk factor for the analysis was vasopressor therapy. The effects of sex, age, history of dialysis, presence/absence of diabetes, bodyweight

TABLE 6. *Basic risk factor*

Risk factor	Hazard ratio	Confidence interval (95%)	*P*-value	Risk factor	Hazard ratio	Confidence interval (95%)	*P*-value
Sex				Hematocrit before dialysis (%)			
Male	1.000	(Control)	Control	<20	1.058	(0.717–1.560)	0.7779
Female	0.877	(0.805–0.956)	0.0027	20 < 25	1.308	(1.136–1.507)	0.0002
Age				25 < 30	1.000	(Control)	Control
Increase every year	1.054	(1.050–1.058)	<0.0001	30 < 35	0.932	(0.850–1.022)	0.1337
History of dialysis (years)				35 < 40	1.066	(0.923–1.232)	0.3841
2 < 5	0.813	(0.741–0.892)	<0.0001	>40	1.217	(0.904–1.639)	0.1958
5 < 10	1.000	(Control)	Control	Dose of erythropoietin (U/week)			
10 < 15	1.192	(1.058–1.343)	0.0039	<1	1.000	(Control)	Control
15 < 20	1.185	(1.005–1.398)	0.0433	1 < 1500	0.664	(0.462–0.952)	0.0261
20 < 25	1.089	(0.868–1.365)	0.4622	1500 < 3000	0.753	(0.637–0.890)	0.0008
>25	1.477	(1.096–1.989)	0.0103	3000 < 4500	0.848	(0.719–1.000)	0.0499
Original cause for starting dialysis				4500 < 6000	1.060	(0.922–1.219)	0.4145
Nondiabetic	1.000	(Control)	Control	6000 < 9000	1.045	(0.892–1.225)	0.5864
Diabetes	1.589	(1.459–1.731)	<0.0001	>9000	1.483	(1.296–1.696)	<0.0001
Percentage weight decrease				Kt/V for urea			
0 < 2	1.216	(1.042–1.420)	0.0130	<0.8	1.974	(1.532–2.543)	<0.0001
2 < 4	1.000	(Control)	Control	0.8 < 1.0	1.280	(1.088–1.507)	0.0029
4 < 6	0.957	(0.869–1.055)	0.3795	1.0 < 1.2	1.000	(Control)	Control
6 < 8	1.191	(1.057–1.341)	0.0040	1.2 < 1.4	0.969	(0.864–1.087)	0.5896
8 < 10	1.482	(1.199–1.831)	0.0003	1.4 < 1.6	0.939	(0.830–1.063)	0.3197
>10	2.408	(1.706–3.399)	<0.0001	1.6 < 1.8	0.865	(0.741–1.010)	0.0674
Serum albumin concentration (g/dL)				>1.8	0.765	(0.622–0.942)	0.0116
<3.0	3.498	(3.050–4.010)	<0.0001				
3.0 < 3.5	1.887	(1.708–2.086)	<0.0001				
3.5 < 4.0	1.000	(Control)	Control				
4.0 < 4.5	0.807	(0.723–0.900)	0.0001				
>4.5	0.847	(0.664–1.079)	0.1788				

TABLE 7. *Epidemiological background of patients in analysis 2*

Blood pressure at the greatest decrease Factor	Less than 120 mm Hg		120–160 mm Hg		Greater than 160 mm Hg	
	Number of patients	(%)	Number of patients	(%)	Number of patients	(%)
Total	18 983	(100.0%)	22 504	(100.0%)	1978	(100.0%)
Sex						
Male	10 188	(53.7%)	14 467	(64.3%)	1400	(70.8%)
Female	8 795	(46.3%)	8 037	(35.7%)	578	(29.2%)
Age (age)						
Mean ± s.d.	61.4 ± 12.8		60.4 ± 12.6		60.2 ± 12.0	
Dialysis (years)						
Mean ± s.d.	9.33 ± 6.54		8.13 ± 5.54		7.15 ± 4.72	
Original cause for starting dialysis						
Nondiabetic	14 305	(75.4%)	16 962	(75.4%)	1315	(66.5%)
Diabetic	4 678	(24.6%)	5 542	(24.6%)	663	(33.5%)
Percentage weight decrease (%)						
Mean ± s.d.	4.82 ± 1.77		4.83 ± 1.77		5.02 ± 2.01	
Serum albumin concentration (g/dL)						
Mean ± s.d.	3.82 ± 0.45		3.89 ± 0.43		3.89 ± 0.43	
Hematocrit before dialysis (%)						
Mean ± s.d.	31.2 ± 4.1		30.5 ± 3.7		29.6 ± 3.8	
Dose of erythropoietin (IU/week)						
Mean ± s.d.	3 616 ± 3 175		4 152 ± 3 022		4947 ± 2977	
Kt/V for urea						
Mean ± s.d.	1.41 ± 0.28		1.37 ± 0.26		1.32 ± 0.26	
Blood pressure at the start of dialysis (mmHg)						
Mean ± s.d.	144 ± 25		159 ± 19		177 ± 14	
Blood pressure at the greatest decrease (mmHg)						
Mean ± s.d.	100 ± 14		134 ± 11		167 ± 8	
Blood pressure at the end of disalysis (mmHg)						
Mean ± s.d.	121 ± 21		147 ± 16		137 ± 24	
Vasopressor treatment						
None	10 393	(54.7%)	17 850	(79.3%)	1689	(85.4%)
Oral and intravenous	2 129	(11.2%)	1 283	(5.7%)	60	(3.0%)
Capacity	4 788	(25.2%)	2 773	(12.3%)	201	(10.2%)
Combined use	1 673	(8.8%)	598	(2.7%)	28	(1.4%)
Outcome						
Alive	16 200	(85.3%)	19 784	(87.9%)	1721	(87.0%)
Dead						
Refusal	4	(0.0%)	2	(0.0%)	0	(0.0%)
Accident	14	(0.1%)	7	(0.0%)	1	(0.1%)
Suicide	3	(0.0%)	13	(0.1%)	2	(0.1%)
Other	1 319	(6.9%)	1 086	(4.8%)	137	(6.9%)
Treat. Change	790	(4.2%)	800	(3.6%)	50	(2.5%)
Uncertain	653	(3.4%)	812	(3.6%)	67	(3.4%)

loss rate, Kt/V, serum albumin concentration, hematocrit before dialysis, and dose of erythropoietin on life expectancy were corrected using the proportional hazard model.

Analysis 3: How to deal with decreased blood pressure

Objective

The results of analysis 2 showed the possibility that vasopressor therapy carried out on patients with blood pressure of less than 120 mm Hg at the greatest decrease increases mortality risk. In contrast, the results showed a high mortality rate for patients with blood pressure of less than 120 mm Hg at the end of dialysis (see the analysis 1 section). It is difficult to conclude that decreased blood pressure should be increased by vasopressor therapy on the basis of the above results only. In an attempt to solve this problem, the combined effect of the vasopressor therapy and blood pressure at the end on the life expectancy of only the patients with blood pressure of less than 120 mm Hg at the greatest decrease was clarified.

TABLE 8. *Outcome of patients in analysis 3*

Blood pressure at the end of dialysis: Vasopressor treatment	Less than 100 mm Hg				100 < 120 mm Hg			
	None	Oral and intravenous	Capacity	Combined use	None	Oral and intravenous	Capacity	Combined use
Alive	930	240	535	232	4072	779	1891	586
Dead								
Refusal	0	0	0	1	0	0	2	0
Accident	0	1	1	0	2	1	3	0
Suicide	0	0	1	0	0	0	0	0
Other	52	33	50	33	264	98	202	89
Treat. change	65	18	30	13	187	36	69	30
Uncertain	38	9	20	8	155	34	79	27
Total	1085	301	637	287	4680	948	2246	732
Blood pressure at the end of dialysis: Vasopressor treatment	120 < 160 mm Hg				Greater than 160 mm Hg			
	None	Oral and intravenous	Capacity	Combined use	None	Oral and intravenous	Capacity	Combined use
Alive	3618	609	1381	454	432	121	240	80
Dead								
Refusal	1	0	0	0	0	0	0	0
Accident	2	0	1	2	0	1	0	0
Suicide	2	0	0	0	0	0	0	0
Other	181	77	93	54	39	14	30	10
Treat. change	187	21	88	20	10	5	6	5
Uncertain	135	27	50	26	21	5	16	3
Total	4126	734	1613	556	502	146	292	98

Subjects

The data of 18 983 patients with blood pressure of less than 120 mm Hg at the greatest decrease in analysis 2 were extracted and subjected to analysis 3.

Classification

The patients were classified according to blood pressure at the end into four groups: less than 100 mm Hg, 100–120 mm Hg, 120–160 mm Hg, and greater than 160 mm Hg. These four groups formed according to blood pressure at the end were combined with the four groups formed according to the vasopressor therapy so the patients were classified into a total of 16 groups (4 ×4). The mortality risks of these groups was calculated (Table 8).

Analysis method

The analysis method used was the proportional hazard model. Life expectancies of the 16 groups classified by both blood pressure at the end and vasopressor therapy were compared. The effects of sex, age, dialysis history, presence/absence of diabetes, weight loss rate, Kt/V, serum albumin concentration, hematocrit before dialysis, and dose of erythropoietin on life expectancy were corrected using the proportional hazard model.

RESULTS AND DISCUSSION—A. SURVEY AT THE END OF 2003

Number of patients

Table 9 shows a summary of the dynamics of the dialysis patient population of Japan at the end of 2003. Only the totals for history of dialysis and history of a patient who underwent the longest dialysis treatment in this table were obtained from the patient survey, the totals for other items were obtained from the facility survey.

According to the total obtained from the results of the facility survey, the dialysis patient population of Japan at the end of 2003 was 237 710. The dialysis patient population of Japan at the end of 2002 was 229 538, showing an increase of 3.6% (8172 patients) from the end of 2002 to the end of 2003. This increase was the smallest in the past 4–6 years. The percentage of collected questionnaires in the 2003 survey was nearly the same as in previous years, as mentioned at the beginning of this report. This might be a sign that the dialysis patient population will decrease in the future.

Similarly, the total dialysis patient population in each prefecture of Japan obtained from the facility survey results is shown in Table 10. The dialysis patient population per million people at the end of

TABLE 9. Number of dialysis centers for patients requiring permanent dialysis in Japan

Number of facilities	3 717 facilities	(Increase of 105 facilities, 2.9% increase)
Facility		
Patient station	92 710 units	(Increase of 3 640 units, 4.1% increase)
Capacity		
Simultaneous dialysis	91 925 people	(Increase of 3 454 persons, 3.9% increase)
Maximum accommodation capacity	312 004 people	(Increase of 23 064 persons, 8.0% increase)
Chronic dialysis patient*	237 710 people	Increase of 8 172 persons
Daytime	187 533 people	(78.9%)
Nighttime	41 202 people	(17.3%)
Home hemodialysis	110 people	(0.0%)
CAPD	8 479 people	(3.6%)
IPD	382 people	(0.2%)
Number of new patients	33 966 people	(Increase of 256 persons, 0.8% increase)
Number of deceased patients	21 672 people	(Increase of 1 058 persons, 4.9% increase)

*The total number of chronic dialysis patients is the sum of the column of the total patient number in sheet I, and does not agree with the total number of patients counted by the method of treatment.

	Male	Female	Undetermined	Total†
Number of dialysis patients who received dialysis for less than 5 years	73 042	44 064	10	117 116 (51.1%)
Number of dialysis patients who received dialysis for 5 years or longer but less than 10 years	33 615	22 547	7	56 169 (24.5%)
Number of dialysis patients who received dialysis for 10 years or longer but less than 15 years	15 295	11 412	3	26 710 (11.6%)
Number of dialysis patients who received dialysis for 15 years or longer but less than 20 years	7 966	6 496	1	14 463 (6.3%)
Number of dialysis patients who received dialysis for 20 years or longer but less than 25 years	5 010	3 982	0	8 992 (3.9%)
Number of dialysis patients who received dialysis for 25 years or longer	3 533	2 462	1	5 996 (2.6%)
Patients per million				1 862.7 people (Increase of 61.5 persons)
Longest dialysis history: 37 years and 6 months				

†The number of dialysis patients was calculated from questionnaire sheets II–IV.

TABLE 10. *Number of chronic patients according to administrative divisions*

Name of administrative divisions	Number of patients	Name of administrative divisions	Number of patients
Hokkaido	11 072	Shiga	2 194
Aomori	2 495	Kyoto	4 856
Iwate	2 421	Osaka	17 447
Miyagi	3 749	Hyogo	9 705
Akita	1 801	Nara	2 419
Yamagata	1 840	Wakayama	2 251
Fukushima	3 703	Tottori	1 137
Ibaraki	5 231	Shimane	1 179
Tochigi	4 354	Okayama	3 749
Gunma	4 226	Hiroshima	5 729
Saitama	11 719	Yamaguchi	2 699
Chiba	9 752	Tokushima	2 075
Tokyo	23 416	Kagawa	2 188
Kanagawa	14 059	Ehime	2 742
Niigata	4 163	Kochi	1 816
Toyama	1 961	Fukuoka	10 422
Ishikawa	2 144	Saga	1 811
Fukui	1 397	Nagasaki	3 102
Yamanashi	1 704	Kumamoto	5 006
Nagano	3 927	Oita	2 999
Gifu	3 403	Miyazaki	3 006
Shizuoka	7 422	Kagoshima	4 174
Aichi	12 578	Okinawa	3 236
Mie	3 231	Total*	237 710

*The total number of chronic dialysis patients is the sum of the column of the total patient number in sheet 1, and does not agree with the total number of patients counted by the method of treatment.

TABLE 11. *Change in number of patients per million*

Year	1983	1984	1985	1986	1987	1988	1989*	1990	1991	1992	1993
Patients per million	443.7	497.5	547.8	604.4	658.8	721.1	790.0	835.7	937.6	995.8	1076.4
Year	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	
Patients per million	1149.4	1229.7	1328.4	1394.9	1472.5	1556.7	1624.1	1721.9	1801.2	1862.7	

*1989: The collection rate is corrected at 86%, i.e. rounded off at the 100th order.

2003 was 1862.7. The increase in dialysis patient population per million people from 2002 to 2003 was also the smallest in the past 4–6 years, as shown in Table 11. These findings also suggest a potential decrease in dialysis patient population.

Mean age

Dialysis patients in Japan are aging every year. According to the results of the patient survey, the mean age of patients newly introduced to dialysis in 2003 was 65.4 years, and the mean age of the entire dialysis patient population at the end of 2003 was 62.3 years (Table 12). The dialysis population has aged at a pace of approximately 0.4–0.7 years every year. However, an increase in the mean age of the dialysis population in 1 year from the end of 2002 to the end of 2003 was only 0.1 years. A difference of only 0.1 years from the mean age of the previous year was observed for the first time since the patient survey started in 1983. These findings might suggest that the aging of the dialysis population is beginning to slow down.

There was a difference of 0.7 years between the mean ages of patients newly introduced to dialysis in 2002 and 2003, and this was nearly the same as the differences observed in previous years.

Table 13 shows the sex and age distributions of patients newly introduced to dialysis in 2003. Table 14 shows the sex and age distributions of all the dialysis patients at the end of 2003. Tables 15 and 16 show the age distribution according to the primary disease. The data in these tables were obtained from the patient survey.

Primary diseases of patients newly introduced to dialysis

The summation results concerning primary diseases for patients newly introduced to dialysis and primary diseases for all the patients at the end of 2003 are shown in Table 15. Tables 17 and 18 show changes in main primary diseases from 1983 to 2003.

The number of patients with diabetic nephropathy as their primary disease increased among patients newly introduced to dialysis in 2003. Not only the percentage, but also the absolute number of patients with chronic glomerulonephritis as the primary disease decreased. Patients with 'undetermined' primary diseases accounted for 8.8% of patients newly introduced to dialysis, that is, the third largest number, following patients with chronic glomerulonephritis. To improve the accuracy of tabulation for primary diseases, it is necessary to investigate primary diseases as much as possible and to reduce the number of patients with 'undetermined' primary diseases. The number of patients with nephrosclerosis as the primary disease began to increase steadily, although their absolute number was still not very large. There are no significant differences in overall statistics regarding the primary diseases other than those described.

The number of patients with diabetic nephropathy as their primary disease also clearly increased among all the dialysis patients. In contrast, the ratio of patients with chronic glomerulonephritis as their primary disease to all the dialysis patients at the end of the year clearly decreased year by year, although their absolute number increased. The number of

TABLE 12. *Change in number of patients newly introduced into dialysis treatment each year and average age of patients at the end of each fiscal year*

Year	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993
Average age of patients newly introduced into dialysis treatment	51.9	53.2	54.4	55.1	55.9	56.9	57.4	58.1	58.1	59.5	59.8
Average age of patients at the end of each year	48.3	49.2	50.3	51.1	52.1	52.9	53.8	54.5	55.3	56.0	56.7
Year	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	
Average age of patients newly introduced into dialysis treatment	60.4	61.0	61.5	62.2	62.7	63.4	63.8	64.2	64.7	65.4	
Average age of patients at the end of each year	57.3	58.0	58.6	59.2	59.9	60.6	61.2	61.6	62.2	62.3	

TABLE 13. *Number of patients newly introduced into dialysis treatment in 2003, age and sex*

Age at which dialysis treatment was introduced	Male	Female	Total
Younger than five years old	11 (0.1)	6 (0.0)	17 (0.1)
5 years old-	7 (0.0)	1 (0.0)	8 (0.0)
10 years old-	10 (0.0)	13 (0.1)	23 (0.1)
15 years old-	26 (0.1)	18 (0.1)	44 (0.1)
20 years old-	83 (0.4)	43 (0.3)	126 (0.4)
25 years old-	154 (0.7)	99 (0.8)	253 (0.8)
30 years old-	288 (1.4)	167 (1.3)	455 (1.4)
35 years old-	416 (2.0)	190 (1.5)	606 (1.8)
40 years old-	551 (2.6)	302 (2.4)	853 (2.5)
45 years old-	950 (4.5)	504 (4.1)	1 454 (4.3)
50 years old-	1 882 (8.9)	1 000 (8.1)	2 882 (8.6)
55 years old-	2 396 (11.4)	1 073 (8.7)	3 469 (10.4)
60 years old-	2 790 (13.2)	1 341 (10.8)	4 131 (12.3)
65 years old-	3 208 (15.2)	1 647 (13.3)	4 855 (14.5)
70 years old-	3 251 (15.4)	1 867 (15.1)	5 118 (15.3)
75 years old-	2 798 (13.3)	1 942 (15.7)	4 740 (14.2)
80 years old-	1 501 (7.1)	1 379 (11.1)	2 880 (8.6)
85 years old-	633 (3.0)	648 (5.2)	1 281 (3.8)
90 years old-	115 (0.5)	141 (1.1)	256 (0.8)
95 yeas old-	18 (0.1)	12 (0.1)	30 (0.1)
Sub total	21 088 (100.0)	12 393 (100.0)	33 481 (100.0)
No description	44	24	68
Grand total	21 132	12 417	33 549
Average	64.55	66.72	65.35
Standard deviation	13.16	13.85	13.46

The numerical value in parentheses on the right-hand side of each number shows the percent with respect to the sum of the column.

patients with diabetic nephropathy as their primary disease is expected to surpass that of patients with chronic glomerulonephritis, like that of patients newly introduced to dialysis in a few years.

The number of patients with 'undetermined' primary disease also began to increase among all the dialysis patients. The number of patients with nephrosclerosis increased gradually. No large changes in

TABLE 14. *Number of patients, age and sex at the end of 2003*

Age at which dialysis treatment was introduced	Male	Female	Total
Younger than five years old	21 (0.0)	15 (0.0)	36 (0.0)
5 years old-	17 (0.0)	11 (0.0)	28 (0.0)
10 years old-	30 (0.0)	16 (0.0)	46 (0.0)
15 years old-	117 (0.1)	81 (0.1)	198 (0.1)
20 years old-	419 (0.3)	234 (0.3)	653 (0.3)
25 years old-	1 030 (0.7)	563 (0.6)	1 593 (0.7)
30 years old-	2 164 (1.6)	1 206 (1.3)	3 370 (1.5)
35 years old-	3 557 (2.6)	1 932 (2.1)	5 489 (2.4)
40 years old-	5 109 (3.7)	2 956 (3.3)	8 065 (3.5)
45 years old-	8 214 (5.9)	4 947 (5.4)	13 161 (5.7)
50 years old-	15 456 (11.2)	9 513 (10.5)	24 969 (10.9)
55 years old-	19 064 (13.8)	11 468 (12.6)	30 532 (13.3)
60 years old-	20 767 (15.0)	12 648 (13.9)	33 415 (14.6)
65 years old-	20 920 (15.1)	12 822 (14.1)	33 742 (14.7)
70 years old-	18 674 (13.5)	11 887 (13.1)	30 561 (13.3)
75 years old-	13 153 (9.5)	10 093 (11.1)	23 246 (10.1)
80 years old-	6 437 (4.7)	6 683 (7.3)	13 120 (5.7)
85 years old-	2 562 (1.9)	3 027 (3.3)	5 589 (2.4)
90 years old-	648 (0.5)	762 (0.8)	1 410 (0.6)
95 yeas old-	66 (0.0)	74 (0.1)	140 (0.1)
Sub total	138 425 (100.0)	90 938 (100.0)	229 363 (100.0)
No description	36	25	61
Grand total	138 461	90 963	229 424
Average	62.07	63.78	62.75
Standard deviation	12.72	13.20	12.94

The numerical value in parentheses on the right-hand side of each number shows the percent with respect to the sum of the column.

TABLE 15. *Number and average age of new patients newly introduced into dialysis classified according to primary disease in 2003*

Primary	Number of patients	Average age	Standard deviation
Chronic glomerulonephritis	9 668 (29.1)	64.45	14.71
Chronic pyelonephritis	323 (1.0)	64.67	14.98
Rapidly progressive glomerulonephritis	390 (1.2)	68.65	12.18
Toxemia of pregnancy	67 (0.2)	55.63	13.29
Unclassified nephritis	122 (0.4)	59.43	19.56
Polycystic kidney	753 (2.3)	59.74	12.53
Renal sclerosis	2 824 (8.5)	72.97	11.45
Malignant hypertension	239 (0.7)	61.27	15.58
Diabetic nephropathy	13 632 (41.0)	64.49	11.31
SLE	245 (0.7)	58.11	15.60
Amyloid kidney	163 (0.5)	65.29	10.14
Gouty nephropathy	133 (0.4)	64.47	12.47
Dysbolic renal failure	21 (0.1)	46.71	19.98
Tuberculosis	28 (0.1)	66.89	8.78
Nephrolithiasis	53 (0.2)	65.15	12.16
Maligant tumor of renal and urinary	160 (0.5)	68.51	13.17
Obstructive uropathy	116 (0.3)	63.84	18.51
Myeloma	130 (0.4)	70.25	10.21
Renal hypoplasia	55 (0.2)	27.02	24.27
Rejection of kidney graft	177 (0.5)	52.84	16.36
Others	996 (3.0)	65.88	15.33
Undetermined	2 925 (8.8)	68.23	13.90
Subtotal	33 220 (100.0)	65.32	13.47
No description	341	68.94	11.88
Grand total	33 561	65.35	13.46

The numerical value in parentheses on the right-hand side of each number shows the percent with respect to the sum of the column.

the number of any other primary diseases were observed.

Causes of death

Table 19 shows the classification of the causes of death of patients newly introduced to dialysis in 2003 obtained from the patient survey. Table 20 shows the classification of the causes of death of all the dialysis patients at the end of 2003. Table 21 shows changes in the ratio of the leading causes of death to all the causes of death since 1983. The cause-of-death code was changed on the basis of

TABLE 16. *Number and average age of patients classified according to primary disease at the end of fiscal year 2003*

Primary disease	Number of patients	Average age	Standard deviation
Chronic glomerulonephritis	106 649 (46.6)	61.19	13.03
Chronic pyelonephritis	3 030 (1.3)	61.11	14.46
Rapidly progressive glomerulonephritis	1 373 (0.6)	62.97	14.49
Toxemia of pregnancy	1 781 (0.8)	56.81	9.57
Unclassified nephritis	1 057 (0.5)	54.33	17.31
Polycystic kidney	7 519 (3.3)	61.53	10.86
Renal sclerosis	12 234 (5.3)	71.98	12.07
Malignant hypertension	1 755 (0.8)	60.99	13.55
Diabetic nephropathy	66 827 (29.2)	64.46	10.87
SLE	2 145 (0.9)	53.74	13.65
Amyloid kidney	464 (0.2)	63.78	11.23
Gouty nephropathy	1 256 (0.5)	63.64	11.74
Dysbolic renal failure	240 (0.1)	46.60	17.21
Tuberculosis	464 (0.2)	66.49	10.30
Nephrolithiasis	476 (0.2)	64.63	11.29
Malignant tumor of renal and urinary	513 (0.2)	67.11	11.64
Obstructive uropathy	640 (0.3)	58.00	18.50
Myeloma	191 (0.1)	68.87	11.27
Renal hypoplasia	490 (0.2)	36.74	18.90
Rejection of kidney graft	1 448 (0.6)	49.24	11.70
Others	3 872 (1.7)	60.40	16.44
Undetermined	14 345 (6.3)	65.08	13.76
Subtotal	228 769 (100.0)	62.74	12.94
No description	677	64.49	13.16
Grand total	229 446	62.75	12.94

The numerical value in parentheses on the right-hand side of each number shows the percent with respect to the sum of the column.

TABLE 17. *Change in number of new patients introduced into dialysis treatment according to primary disease for each year*

Year	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993
Diabetic nephropathy	15.6	17.4	19.6	21.3	22.1	24.3	26.5	26.2	28.1	28.4	29.9
Chronic glomerulonephritis	60.5	58.7	56.0	54.8	54.2	49.9	47.4	46.1	44.2	42.2	41.4
Renal sclerosis	3.0	3.3	3.5	3.7	3.9	3.9	4.1	5.4	5.5	5.9	6.2
Polycystic kidney	2.8	2.8	3.1	2.9	3.2	3.1	3.1	2.9	3.0	2.7	2.6
Chronic pyelonephritis	2.4	2.2	2.1	2.0	1.8	1.8	1.5	1.5	1.7	1.6	1.1
Rapidly progressive glomerulonephritis	0.9	0.7	0.9	1.0	0.8	0.9	0.8	0.7	0.6	0.7	0.8
SLE	1.1	1.1	1.1	1.2	0.9	0.9	1.0	1.1	1.3	1.3	1.2
Undetermined	4.4	4.0	4.8	4.2	4.1	3.8	4.0	3.3	3.7	3.7	3.3

Year	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
Diabetic nephropathy	30.7	31.9	33.1	33.9	35.7	36.2	36.6	38.1	39.1	41.0
Chronic glomerulonephritis	40.5	39.4	38.9	36.6	35.0	33.6	32.5	32.4	31.9	29.1
Renal sclerosis	6.1	6.3	6.4	6.8	6.7	7.0	7.6	7.6	7.9	8.5
Polycystic kidney	2.5	2.4	2.5	2.4	2.4	2.2	2.4	2.3	2.4	2.3
Chronic pyelonephritis	1.4	1.2	1.1	1.2	1.1	1.1	1.0	1.1	0.9	1.0
Rapidly progressive glomerulonephritis	0.8	0.8	0.8	1.1	0.9	0.9	1.0	1.0	1.1	1.2
SLE	1.2	1.1	1.3	1.0	1.1	1.2	0.9	1.0	0.9	0.7
Undetermined	3.9	4.5	5.0	5.5	5.6	6.1	7.6	9.0	8.4	8.8

TABLE 18. *Change in primary disease of patient at the end of each fiscal year*

Year	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993
Diabetic nephropathy	7.4	8.4	9.4	10.5	11.7	12.8	14.0	14.9	16.4	17.1	18.2
Chronic glomerulonephritis	74.5	72.1	72.3	70.6	69.4	67.9	65.9	64.1	61.7	60.4	58.8
Renal sclerosis	1.5	1.7	1.9	2.0	2.1	2.1	2.3	2.6	2.9	3.1	3.4
Polycystic kidney	2.7	2.9	3.0	3.1	3.1	3.2	3.2	3.3	3.3	3.3	3.3
Chronic pyelonephritis	3.1	3.3	2.6	2.4	2.4	2.3	2.2	2.2	2.1	2.0	1.9
Rapidly progressive glomerulonephritis	0.5	0.4	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
SLE	0.8	0.8	0.9	0.9	0.9	0.9	0.9	1.0	1.1	1.1	1.1
Undetermined	2.2	2.3	2.3	2.5	2.6	2.5	2.6	2.6	2.9	2.9	2.9

Year	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
Diabetic nephropathy	19.2	20.4	21.6	22.7	24.0	25.1	26.0	27.2	28.1	29.2
Chronic glomerulonephritis	57.7	56.6	55.4	54.1	52.5	51.1	49.7	49.6	48.3	46.6
Renal sclerosis	3.6	3.8	4.0	4.2	4.4	4.5	4.8	5.0	5.1	5.3
Polycystic kidney	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.3	3.3	3.3
Chronic pyelonephritis	1.8	1.7	1.6	1.6	1.5	1.5	1.4	1.4	1.3	1.3
Rapidly progressive glomerulonephritis	0.5	0.5	0.5	0.6	0.6	0.6	0.6	0.6	0.6	0.6
SLE	1.1	1.1	1.1	1.1	1.1	1.1	1.0	1.0	1.0	0.9
Undetermined	3.1	3.2	3.6	3.9	4.2	4.4	5.0	5.6	5.9	6.3

TABLE 19. *Classification of cause of death of patients newly introduced into dialysis treatment in 2003*

Cause of death	Male	Female	Sub total	No description	Grand total
Heart failure (%)	421 (22.8)	227 (25.7)	698 (23.9)		698 (23.9)
Cerebrovascular disorder (%)	138 (7.5)	84 (7.8)	222 (7.6)		222 (7.6)
Infectious disease (%)	445 (24.1)	252 (23.4)	697 (23.8)		697 (23.8)
Bleeding (%)	45 (2.4)	22 (2.0)	67 (2.3)		67 (2.3)
Malignant tumor (%)	193 (10.4)	86 (8.0)	279 (9.5)		279 (9.5)
Cachexia/Uremia (%)	44 (2.4)	31 (2.9)	75 (2.6)		75 (2.6)
Myocardial infarction (%)	75 (4.1)	48 (4.5)	123 (4.2)		123 (4.2)
Potassium intoxication/sudden death (%)	71 (3.8)	47 (4.4)	118 (4.0)		118 (4.0)
Chronic hepatitis/Cirrhosis (%)	43 (2.3)	20 (1.9)	63 (2.2)		63 (2.2)
Encephalopathy (%)	5 (0.3)	2 (0.2)	7 (0.2)		7 (0.2)
Suicide/Rejection (%)	31 (1.7)	12 (1.1)	43 (1.5)		43 (1.5)
Ileus (%)	10 (0.5)	6 (0.6)	16 (0.5)		16 (0.5)
Pulmonary thromboembolism (%)	12 (0.6)	7 (0.6)	19 (0.6)		19 (0.6)
Accidental death (%)	14 (0.8)	6 (0.6)	20 (0.7)		20 (0.7)
Others (%)	184 (10.0)	117 (10.9)	301 (10.3)		301 (10.3)
Undetermined (%)	116 (6.3)	61 (5.7)	177 (6.1)		177 (6.1)
Sub total (%)	1847 (100.0)	1078 (100.0)	2925 (100.0)	0	2925 (100.0)
No description	40	23	63		63
Grand total	1887	1101	2988	0	2988

The numerical value in parentheses on the right-hand side of each number shows the percent with respect to the sum of the column.

TABLE 20. *Classification of cause of death of patients in 2003*

Cause of death	Male	Female	Subtotal	No description	Grand total
Heart failure (%)	2 954 (23.8)	2029 (27.0)	4 983 (25.0)		4 983 (25.0)
Cerebrovascular disorder (%)	1 296 (10.5)	842 (11.2)	2 138 (10.7)		2 138 (10.7)
Infectious disease (%)	2 345 (18.9)	1.341 (17.8)	3 686 (18.5)	1 (20.0)	3 687 (18.5)
Bleeding (%)	267 (2.2)	180 (2.4)	447 (2.2)		447 (2.2)
Malignant tumor (%)	1 208 (9.7)	476 (6.3)	1.684 (8.5)	1 (20.0)	1 685 (8.5)
Cachexia/Uremia (%)	288 (2.3)	246 (3.3)	534 (2.7)		534 (2.7)
Myocardial infarction (%)	784 (6.3)	459 (6.1)	1 243 (6.2)	1 (20.0)	1.244 (6.2)
Potassium intoxication/sudden death (%)	721 (5.8)	381 (5.1)	1 102 (5.5)	1 (20.0)	1 103 (5.5)
Chronic hepatitis/Cirrhosis (%)	249 (2.0)	83 (1.1)	332 (1.7)		332 (1.7)
Encephalopathy (%)	16 (0.1)	12 (0.2)	28 (0.1)		28 (0.1)
Suicide/Rejection (%)	172 (1.4)	62 (0.8)	234 (1.2)		234 (1.2)
Ileus (%)	109 (0.9)	90 (1.2)	199 (1.0)		199 (1.0)
Pulmonary thromboembolism (%)	52 (0.4)	32 (0.4)	84 (0.4)		84 (0.4)
Accidental death (%)	127 (1.0)	62 (0.8)	189 (0.9)		189 (0.9)
Others (%)	1 107 (8.9)	823 (10.9)	1 930 (9.7)	1 (20.0)	1 931 (9.7)
Undetermined (%)	705 (5.7)	404 (5.4)	1 109 (5.6)		1 109 (5.6)
Subtotal (%)	12 400 (100.0)	7522 (100.0)	19 922 (100.0)	5 (100.0)	19 927 (100.0)
No description	243	127	370	2	372
Grand total	12 643	7649	20 292	7	20 299

The numerical value in parentheses on the right-hand side of each number shows the percent with respect to the sum of the column.

ICD-10 classification starting with this survey, as mentioned earlier.

There are some differences in the causes of death between male and female patients newly introduced to dialysis. That is, the causes of death of the male patients newly introduced to dialysis were infectious disease (24.1%), cardiac failure (22.8%), and malignant tumors(10.4%), but those of the female patients were cardiac failure (25.7%), infectious disease (23.4%) and malignant tumors (8.0%).

With regards to the causes of death for the entire dialysis population, cardiac failure was the leading cause of death for both male and female patients. The incidence of death from cardiac failure tended to be higher for female patients than for male patients, but that from malignant tumors tended to be higher for male patients than for female patients.

Changes in the major causes of death showed increased incidences of death from infectious disease and decreased incidence of death from myocardial infarction, although no large change was observed. The cause-of-death classification was changed to that based on ICD-10 starting with the present survey. It is difficult to ascertain whether the difference between the distributions of the causes of death in the preceding year's survey and the present survey reflected actual changes in the distributions of the causes of death, or a methodological change associated with the changed disease classification method. It is necessary to assess the changes in the distribution of the causes of death after analyzing the tabulated results according to the new classification for several years.

Annual crude death rate

The annual crude death rate was calculated from the results of the facility survey. The annual crude death rate, that is, the rate of the mean number of the dialysis patients at the end of 2002 and that at the end of 2003 to that of the patients who died in 2003, was 9.3%.

Changes in crude death rate during the past decade are shown in Table 22. The crude death rates during these 10 years ranged from 9.2% to 9.7% and showed no definite tendency toward an increase or a decrease.

The life expectancy of dialysis patients in Japan is considered to have begun to improve substantially with the increases in the numbers of diabetic patients with a low life expectancy and elderly patients taken into account.

Annual 1-year, 5-year, 10-year and 15-year survival rates of patients newly introduced to dialysis

For patients newly introduced to dialysis in or after 1983, 1-year, 5-year, 10-year and 15-year survival rates, and 20-year survival rate, which is first analyzed in this survey, were compared for every year of first introduction (Table 23).

This survey showed that the 1-year survival rate of patients newly introduced to dialysis in 2002 was 0.873. This was equal to the 1-year survival rate of patients newly introduced to dialysis in 2001.

The 5-year survival rate of patients newly introduced to dialysis in and after 1993 tended to improve. The 5-year survival rate of patients newly introduced

TABLE 21. *Change in the percentage of main cause of death in each year*

Year	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
Heart failure	30.3	30.5	31.3	33.2	32.7	36.5	33.4	30.4	30.5	31.1	29.9	28.2	25.4	24.1	23.9	24.1	24.3	23.2	25.5	25.1	25.0
Infectious disease	14.2	11.0	11.5	12.0	12.0	12.2	11.7	11.6	12.1	11.3	12.2	12.6	13.8	14.6	14.9	15.0	16.3	16.6	16.3	15.9	18.5
Cerebrovascular disorder	11.0	14.2	14.2	14.0	14.2	12.9	13.2	13.9	13.7	13.6	13.5	14.1	13.5	12.9	12.6	12.1	11.3	11.3	11.6	11.2	10.7
Malignant tumor	7.7	6.9	6.4	6.9	5.8	6.9	7.6	8.2	7.6	7.1	7.4	7.3	7.2	7.7	8.1	7.7	7.6	8.3	8.5	8.5	8.5
Myocardial infarction	5.3	4.8	5.3	6.1	6.0	5.4	5.3	5.8	5.8	5.8	5.7	7.1	7.5	7.4	8.4	7.9	7.4	7.0	7.4	7.4	6.2
Others	5.1	4.9	5.7	4.7	5.2	4.8	4.4	4.6	4.4	4.5	4.1	4.5	5.8	6.3	6.7	7.0	7.7	7.9	9.1	9.0	9.7

to dialysis in 1998 was 0.614, the highest rate in and after 1985.

The 10-year survival rate of patients newly introduced to dialysis in 1989 began to decrease gradually after it reached its peak. The 10-year survival rate of patients newly introduced to dialysis in 1993 was higher than that (0.389) of patients newly introduced to dialysis in 1992; however, generally, the 10-year survival rate began to decrease yearly.

The 15-year survival rate of patients newly introduced to dialysis in 1988 was 0.287, the lowest rate but breaking the record since the start of the patient survey in 1983.

In addition, the 20-year survival rate of patients newly introduced to dialysis in 1983 was 0.269, which is the first attempt to calculate it.

The cumulative survival rates shown in the present report were calculated with no corrections made for changes in age distribution or primary disease distribution each year. The findings that the 1-year and 5-year survival rates of patients newly introduced to dialysis did not necessarily decline despite continuous increases in the numbers of elderly and diabetic patients are thus considered to be caused by improvements in dialysis technology.

Time from meal taken before blood sampling to blood sampling and serum lipid concentrations

It is necessary to consider mealtime and blood collection time in an investigation of serum lipid concentrations. In the present survey, the time from meal taken before blood sampling to blood sampling (hereafter, elapsed time) was also investigated. The relationships between elapsed time and serum lipid concentrations are shown in Table 24. No marked relationship was observed between the elapsed time and any serum lipid concentrations. The summation and analysis of the serum lipid concentrations was carried out for all the data obtained from the survey without selecting data in terms of elapsed time.

Serum lipid concentrations

Table 25 shows the mean serum lipid concentrations according to patient age. Patients less than 15 years of age exhibited higher mean serum lipid concentrations. The mean serum total cholesterol concentration and mean serum neutral fat concentration also gradually peaked mainly in patients between the ages of 30 and 60 years, and these decreased gradually with age in patients 60 years old or older.

The mean serum HDL-cholesterol concentration tended to decrease with age in all the age groups. However, the mean serum LDL-cholesterol concen-

TABLE 22. *Change in crude death rate (%) per year*

Year	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993
Crude death rate (%)	9.0	8.9	9.1	9.0	8.5	9.2	7.9	9.6	8.9	9.7	9.4
Year	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	
Crude death rate (%)	9.5	9.7	9.4	9.4	9.2	9.7	9.2	9.3	9.2	9.3	

tration was the lowest in patients between the ages of 15 and 30 years, and subsequently tended to increase gradually with age.

Table 26 shows the mean serum lipid concentrations according to sex. The mean serum lipid concentrations were higher in female patients than in male patients.

Table 27 shows the mean serum lipid concentrations according to the years spent on dialysis. The mean serum total cholesterol concentration, mean serum neutral fat concentration and mean serum low density lipoprotein (LDL)-cholesterol concentration tended to decrease very gradually, as the years on dialysis lengthened. In contrast, the mean serum high density lipoprotein (HDL)-cholesterol concentration tended to increase very gradually as the years on dialysis lengthened.

Table 28 shows the mean serum lipid concentrations according to the dialysis method. The mean serum total cholesterol concentration, mean serum neutral fat concentration, and mean serum LDL-cholesterol concentration were higher for continuous ambulatory peritoneal dialysis (CAPD) and intermittent peritoneal dialysis (IPD) than for the other blood purification methods using extracorporeal circulation. This suggests the potential effect of glucose contained in peritoneal dialysate.

All the serum lipid concentrations tended to be higher for home dialysis among blood purification methods using extracorporeal circulation, but no marked difference was observed between the other methods. Table 29 shows the mean serum lipid concentrations according to the primary disease. The comparison between chronic glomerulonephritis and diabetic nephropathy showed that the mean serum total cholesterol concentration was slightly lower in patients with diabetic nephropathy than in those with chronic glomerulonephritis, although the mean serum neutral fat concentration was higher.

The mean serum HDL-cholesterol concentration was lower in patients with diabetic nephropathy than in those with any other primary diseases. This might suggest an abnormality of lipid metabolism associated with diabetes. No clear tendency was observed in the relationship between the mean serum LDL-cholesterol concentration and primary disease.

Tables 30–33 show patient distributions with respect to serum lipid concentrations.

Table 34 shows the relationships between the types of anticoagulant used during blood purification using extracorporeal circulation and the mean serum lipid concentrations. The adverse effects of regular heparins on lipid metabolism were reported to be marked, whereas those of low-molecular-weight heparins were reported to be negligible. The present survey showed that the serum lipid concentrations were slightly lower in patients for whom low-molecular-weight heparins were used than in those for whom regular heparins were used.

Dialysate calcium concentration

Dialysates with calcium concentrations from 3.0 to 3.5 mEq/L were generally used previously so the calcium balance would not be negative. However, patients exhibiting hypercalcemia caused by the use of vitamin D preparations for the treatment of secondary hyperparathyroidism and calcium preparations for phosphate binding have recently been observed. To prevent this adverse effect, dialysates with calcium concentrations lower than 3.0 mEq/L are now also used.

Table 35 shows the distribution of dialysate calcium concentrations in dialysis patients. Dialysates with calcium concentrations ranging from 3.0 mEq/L to less than 3.5 mEq/L were used for the majority (55.4%) of dialysis patients, but those with calcium concentrations ranging from 2.5 mEq/L to less than 2.75 mEq/L were also used for 34.7% of dialysis patients.

The distribution of the number of dialysis patients with respect to dialysate calcium concentrations is expected to also change in the future following the spread of recently developed phosphate binders containing no calcium.

Table 36 shows the mean predialysis serum calcium concentration, mean predialysis serum phosphate concentration and mean serum intact parathyroid hormone (PTH) concentration. The serum intact PTH concentration tended to be higher and the mean predialysis serum calcium concentration tended to be lower in the group with a low dialysate calcium concentration. These findings are

TABLE 23. *Change in survival rate of patients newly introduced into dialysis treatment for each of the following years: 1 years, 5 years, 10 years, 15 years and 20 years*

Year	Number of people	1-year survival rate	2-year survival rate	3-year survival rate	4-year survival rate	5-year survival rate	6-year survival rate	7-year survival rate	8-year survival rate	9-year survival rate	10-year survival rate	11-year survival rate	12-year survival rate	13-year survival rate	14-year survival rate	15-year survival rate	16-year survival rate	17-year survival rate	18-year survival rate	19-year survival rate	20-year survival rate
1983	11 020	0.837	0.773	0.714	0.669	0.629	0.598	0.567	0.531	0.502	0.472	0.443	0.420	0.396	0.377	0.356	0.336	0.319	0.301	0.285	0.269
1984	11 997	0.837	0.764	0.705	0.659	0.619	0.583	0.545	0.514	0.485	0.456	0.428	0.403	0.378	0.356	0.336	0.319	0.299	0.284	0.269	
1985	12 902	0.816	0.748	0.694	0.646	0.604	0.563	0.528	0.489	0.458	0.431	0.406	0.382	0.357	0.334	0.315	0.296	0.277	0.260		
1986	14 174	0.820	0.753	0.700	0.655	0.606	0.562	0.524	0.490	0.455	0.426	0.399	0.375	0.353	0.331	0.313	0.294	0.276			
1987	15 377	0.835	0.766	0.705	0.646	0.598	0.552	0.509	0.474	0.443	0.414	0.389	0.365	0.342	0.320	0.300	0.283				
1988	16 876	0.845	0.769	0.701	0.643	0.591	0.545	0.503	0.468	0.434	0.404	0.377	0.353	0.330	0.307	0.287					
1989	16 840	0.867	0.787	0.720	0.654	0.601	0.554	0.510	0.472	0.437	0.406	0.380	0.354	0.330	0.309						
1990	19 256	0.857	0.776	0.707	0.647	0.595	0.545	0.504	0.466	0.432	0.401	0.372	0.346	0.322							
1991	21 276	0.847	0.763	0.696	0.637	0.582	0.534	0.492	0.456	0.424	0.393	0.365	0.339								
1992	23 153	0.843	0.759	0.688	0.630	0.576	0.530	0.488	0.451	0.418	0.389	0.362									
1993	24 429	0.854	0.773	0.703	0.640	0.588	0.539	0.496	0.458	0.424	0.392										
1994	25 068	0.850	0.772	0.705	0.644	0.589	0.539	0.496	0.457	0.421											
1995	26 834	0.861	0.784	0.716	0.653	0.599	0.552	0.508	0.469												
1996	29 288	0.854	0.781	0.712	0.654	0.601	0.555	0.505													
1997	30 072	0.860	0.784	0.720	0.662	0.607	0.558														
1998	31 594	0.866	0.795	0.732	0.673	0.614															
1999	33 119	0.872	0.801	0.738	0.676																
2000	35 779	0.875	0.801	0.738																	
2001	37 019	0.873	0.800																		
2002	36 104	0.873																			

attributable to the possibility that the dialysate calcium concentration was reduced for patients undergoing treatment of secondary hyperparathyroidism.

Anticoagulants

Heparin has conventionally been used as an anticoagulant for dialysis. A protease inhibitor (nafamostat mesilate) having a short half-life is useful for patients suffering from an accompanying hemorrhagic lesion, but has its shortcomings, it is expensive and cannot be used for a long time. Low-molecular-weight heparin has recently been developed and has started to be used widely because the incidence of adverse reactions to such heparin is low. That is, low-molecular-weight heparin is less likely to aggravate a bleeding tendency because of its dominant anti-Xa activity.

Table 37 shows the summation results for methods of treatment and the status of anticoagulant use regarding blood purification using extracorporeal circulation. Dialysis with the use of regular heparins accounted for 79.3% and that with the use of low-molecular-weight heparins accounted for 18.8%.

RESULTS—B. ANALYSES OF RELATIONSHIPS BETWEEN CHANGES IN BLOOD PRESSURE DURING DIALYSIS AND LIFE EXPECTANCY

Analysis 1: Relationships of blood pressures at the start, at the greatest decrease and at the end with vasopressor therapy and life expectancy

Blood pressure at the start (*Table 38)*

A significantly high mortality risk was observed in patients with blood pressure of less than 120 mm Hg at the start. A high mortality risk was also observed at nearly significant levels for blood pressures of 180 mm Hg or higher and 120–140 mm Hg at the start.

Blood pressure at the greatest decrease (*Table 39)*

A significantly high mortality risk was observed for both blood pressures of less than 120 mm Hg and higher than 160 mm Hg at the greatest decrease.

Blood pressure at the end (*Table 40)*

A significantly high mortality risk was observed for blood pressure of less than 100 mm Hg at the end.

Vasopressor therapies (*Table 41)*

The highest mortality risk was observed for the group administered concomitant vasopressor therapies, and this group was followed by those given an oral/intravenous vasopressor therapy and a volume-

TABLE 24. *Relationships between various mean serum lipid values and time of blood sampling from meal (elapsed time)*

	Total serum cholesterol (mg/dL)		Serum neutral fat (mg/dL)		Serum HDL cholesterol (mg/dL)		Serum LDL cholesterol (mg/dL)	
Time from meal	Average	Standard deviation	Average	Standard deviation	Average	Standard deviation	Average	Standard deviation
Less than 1 h	159.92	39.20	125.11	86.41	47.26	21.70	91.70	31.96
1 h–	158.93	38.82	111.85	67.05	46.06	18.70	90.97	31.45
2 h–	160.14	38.04	113.61	71.43	46.30	18.62	91.58	31.08
3 h–	160.12	37.50	112.45	69.00	46.32	17.82	91.42	30.29
4 h–	157.49	35.79	120.46	81.34	47.24	19.86	87.11	29.17
5 h–	155.90	34.00	118.68	79.94	47.47	18.37	85.65	28.20
6 h–	157.23	33.25	117.24	75.98	47.87	16.45	85.32	27.94
7 h–	156.46	35.61	112.23	58.11	47.91	18.69	85.26	28.29
8 h–	158.52	34.47	108.00	70.31	48.58	16.91	88.85	27.87
9 h–	169.13	39.25	112.08	70.38	48.21	17.53	98.01	31.19
Subtotal	159.66	37.69	114.04	71.81	46.53	18.53	90.84	30.71
No description	159.48	38.23	113.55	71.37	46.60	18.71	90.71	31.17
Grand total	159.60	37.90	113.87	71.66	46.56	18.59	90.80	30.86

type vasopressor therapy in this order. That is, the mortality risk was the lowest in the group not given vasopressor therapy, which served as the control group.

Analysis 2: Relationships between vasopressor therapy patients classified by blood pressure at the greatest decrease and life expectancy

Patient groups with blood pressure of less than 120 mm Hg at the greatest decrease (*Table 42)*

Mortality risks for vasopressor therapies observed in these groups were slightly greater than those obtained by the analysis of all patient groups.

Patient groups with blood pressure from 120 to 160 mm Hg at the greatest decrease (*Table 43)*

No significant mortality risk was observed.

Patient groups with blood pressure of higher than 160 mm Hg at the greatest decrease (*Table 44)*

A significantly high mortality risk was observed only in the patients who underwent an 'oral/intravenous' vasopressor therapy.

TABLE 25. *Mean lipid values according to age*

	Total serum cholesterol (mg/dL)		Serum neutral fat (mg/dL)		Serum HDL cholesterol (mg/dL)		Serum LDL cholesterol (mg/dL)	
Age	Average	Standard deviation	Average	Standard deviation	Average	Standard deviation	Average	Standard deviation
Less than 15 years old	201.55	68.55	182.24	135.38	53.29	19.87	113.90	47.97
15 years old–	152.89	38.42	107.00	69.67	50.55	22.11	80.87	31.12
30 years old–	161.30	37.57	125.22	89.39	49.54	19.99	87.26	30.61
45 years old–	162.36	38.57	122.28	79.63	47.88	18.54	90.48	31.44
60 years old–	158.63	37.76	111.32	66.89	45.53	18.47	91.44	30.84
75 years old–	157.22	36.85	102.36	57.14	45.23	17.85	91.97	29.84
90 years old–	151.76	35.17	90.80	50.35	46.18	16.24	88.00	26.37
Subtotal	159.66	37.90	113.87	71.66	46.56	18.59	90.80	30.86
No description	157.43	43.50	101.57	33.99	43.17	20.07	60.33	24.35
Grand total	159.60	37.90	113.87	71.66	46.56	18.59	90.80	30.86

TABLE 26. *Mean lipid values according to sex*

	Total serum cholesterol (mg/dL)		Serum neutral fat (mg/dL)		Serum HDL cholesterol (mg/dL)		Serum LDL cholesterol (mg/dL)	
Sex	Average	Standard deviation	Average	Standard deviation	Average	Standard deviation	Average	Standard deviation
Male	151.74	35.36	111.90	74.05	44.45	18.00	85.47	29.09
Female	171.54	38.49	116.85	67.75	49.79	19.01	98.94	31.69
Subtotal	159.60	37.69	113.86	71.66	46.56	18.59	90.80	30.86
No description	161.45	42.50	148.65	86.24	36.86	9.42	100.21	35.71
Grand total	159.60	37.90	113.87	71.66	46.56	18.59	90.80	30.86

TABLE 27. *Mean lipid values according to dialysis history*

	Total serum cholesterol (mg/dL)		Serum neutral fat (mg/dL)		Serum HDL cholesterol (mg/dL)		Serum LDL cholesterol (mg/dL)	
Duration of dialysis	Average	Standard deviation	Average	Standard deviation	Average	Standard deviation	Average	Standard deviation
Less than 2 years	162.97	40.05	118.53	72.80	45.71	19.27	94.11	32.84
2 years–	159.70	37.84	115.61	73.62	45.75	18.69	91.40	30.71
5 years–	158.40	37.16	112.63	72.20	46.66	17.73	89.84	30.14
10 years–	158.25	36.60	110.23	70.16	47.66	17.54	88.95	29.96
15 years–	158.29	35.98	109.07	66.36	48.59	20.73	88.53	29.68
20 years–	156.22	36.26	107.71	65.40	48.30	17.91	87.23	29.34
25 years–	153.88	35.52	104.63	61.37	47.70	18.33	85.79	27.96
Total	159.60	37.90	113.87	71.66	46.56	18.59	90.80	30.86

TABLE 28. *Mean lipid values according to treatment method*

	Total serum cholesterol (mg/dL)		Serum neutral fat (mg/dL)		Serum HDL cholesterol (mg/dL)		Serum LDL cholesterol (mg/dL)	
Treatment method	Average	Standard deviation	Average	Standard deviation	Average	Standard deviation	Average	Standard deviation
Hemodialysis	158.87	37.39	113.05	70.89	46.43	18.36	90.41	30.48
Hemodiafiltration	158.65	37.71	110.93	69.06	48.10	20.62	88.67	30.50
Hemofiltration	156.91	39.11	126.72	68.74	44.86	17.22	93.07	30.91
Hemodiabsorption	152.25	38.41	104.42	58.31	48.08	15.71	83.22	33.79
Home hemodialysis	175.56	38.39	137.65	91.33	55.55	20.44	94.93	30.80
CAPD	190.33	43.30	154.24	94.27	47.34	22.18	113.36	36.16
IPD	186.43	56.47	139.80	89.21	45.66	16.16	117.33	65.29
Total	159.60	37.90	113.87	71.66	46.56	18.59	90.80	30.86

TABLE 29. *Mean lipid values according to primary diseases*

	Total serum cholesterol (mg/dL)		Serum neutral (mg/dL)		Serum HDL cholesterol (mg/dL)		Serum LDL cholesterol (mg/dL)	
Primary disease	Average	Standard deviation	Average	Standard deviation	Average	Standard deviation	Average	Standard deviation
Chronic glomerulonephritis	160.12	37.22	111.20	70.43	48.05	18.35	90.29	30.53
Chronic pyelonephritis	162.12	37.80	109.24	66.37	49.79	19.36	91.13	30.67
Rapidly progressive glomerulonephritis	169.12	44.31	113.53	68.51	50.53	19.68	96.77	34.60
Toxemia of pregnancy	171.99	36.99	117.49	68.54	51.26	17.78	97.31	30.72
Unclassified nephritis	159.24	36.77	110.15	70.29	48.60	19.11	89.04	30.64
Polycystic kidney	158.38	34.68	107.09	62.53	47.24	17.34	90.37	28.34
Renal sclerosis	160.56	36.42	108.05	68.85	45.98	16.34	92.87	29.91
Malignant hypertension	162.37	36.41	121.69	79.92	48.13	19.74	91.29	30.60
Diabetic nephropathy	157.60	39.08	120.83	75.37	42.99	18.07	90.93	31.69
SLE	171.02	39.71	118.31	65.89	52.32	18.05	95.47	31.66
Amyloid kidney	168.12	44.95	110.04	60.44	50.97	15.92	95.74	37.79
Gouty nephropathy	152.16	33.51	113.58	74.02	45.95	17.94	84.20	26.69
Dysbolic renal failure	154.50	41.40	118.58	96.73	48.15	17.86	81.18	29.23
Tuberculosis	156.90	38.55	98.87	57.01	49.83	17.15	87.67	30.11
Nephrolithiasis	159.51	37.46	108.84	70.53	48.43	18.33	88.72	31.58
Malignant tumor of renal and urinary	156.23	37.48	105.28	60.71	45.97	15.55	90.19	29.65
Obstructive uropathy	161.69	38.02	110.82	74.47	48.55	18.53	92.19	30.34
Myeloma	165.66	44.49	121.19	78.93	45.98	14.51	93.60	38.81
Renal hypoplasia	159.80	44.21	110.93	75.71	52.54	19.57	86.32	32.79
Rejection of kidney graft	158.55	36.49	120.96	73.27	47.28	17.89	87.77	29.42
Others	160.75	40.44	112.55	71.36	48.73	21.17	91.74	33.28
Undetermined	160.11	37.88	110.46	69.25	47.82	22.10	91.36	30.33
Subtotal	159.59	37.89	113.87	71.66	46.56	18.59	90.79	30.86
No description	160.25	39.43	112.22	68.00	44.25	16.03	96.64	33.61
Grand total	159.60	37.90	113.87	71.66	46.56	18.59	90.80	30.86

TABLE 30. *Number of patients (patient distribution) with respect to serum total cholesterol concentration*

Total cholesterol	Number of patients (%)
Less than 60	327 (0.2)
60–	780 (0.4)
80–	5 101 (2.7)
100–	18 187 (9.7)
120–	34 301 (18.3)
140–	41 582 (22.1)
160–	36 713 (19.5)
180–	24 839 (13.2)
200–	13 980 (7.4)
220–	7 023 (3.7)
240–	2 908 (1.5)
260–	1 211 (0.6)
280–	472 (0.3)
300–	340 (0.2)
350–	105 (0.1)
Subtotal	187 869 (100.0)
No description	41 577
Grand total	229 446
Average	159.60
Standard deviation	37.90

The numerical value in parentheses beneath each number shows the percent with respect to the sum of the column.

TABLE 31. *Number of patients (patient distribution) with respect to serum neutral fat concentration*

Total cholesterol	Number of patients (%)
Less than 50	16 492 (9.5)
50–	28 899 (16.6)
70–	31 508 (18.1)
90–	26 393 (15.2)
110–	20 139 (11.6)
130–	14 493 (8.3)
150–	10 278 (5.9)
170–	7 079 (4.1)
190–	4 811 (2.8)
210–	3 416 (2.0)
230–	2 490 (1.4)
250–	7 854 (4.5)
Subtotal	173 852 (100.0)
No description	55 594
Grand total	229 446
Average	113.87
Standard deviation	71.66

The numerical value in parentheses beneath each number shows the percent with respect to the sum of the column.

TABLE 32. *Number of patients (patient distribution) with respect to serum HDL cholesterol concentration*

Total cholesterol	Number of patients (%)
Less than 10	112 (0.1)
10–	869 (0.7)
20–	13 595 (10.4)
30–	34 852 (26.7)
40–	35 137 (27.0)
50–	23 287 (17.9)
60–	12 306 (9.4)
70–	5 587 (4.3)
80–	2 346 (1.8)
80–	992 (0.8)
100–	1 241 (1.0)
Subtotal	130 324 (100.0)
No description	99 122
Grand total	229 446
Average	46.56
Standard deviation	18.59

The numerical value in parentheses beneath each number shows the percent with respect to the sum of the column.

TABLE 33. *Number of patients (patient distribution) with respect to serum LDL cholesterol*

Total cholesterol	Number of patients (%)
Less than 40	3 204 (2.6)
40–	14 491 (11.6)
60–	30 387 (24.2)
80–	33 355 (26.6)
100–	23 511 (18.8)
120–	12 132 (9.7)
140–	5 223 (4.2)
160–	1 976 (1.6)
180–	670 (0.5)
200–	380 (0.3)
Subtotal	125 329 (100.0)
No description	104 117
Grand total	229 446
Average	90.80
Standard deviation	30.86

The numerical value in parentheses beneath each number shows the percent with respect to the sum of the column.

No description is made when the calculated result is negative or TG (triglycerides) ≥ 400.

TABLE 34. *Mean lipid value according to type of anticoagulant*

	Total serum cholesterol (mg/dL)		Serum neutral fat (mg/dL)		Serum HDL cholesterol (mg/dL)		Serum LDL cholesterol (mg/dL)	
Anticoagulant	Average	Standard deviation	Average	Standard deviation	Average	Standard deviation	Average	Standard deviation
Heparin-type agents	159.73	36.94	113.56	70.95	46.95	18.31	90.62	30.26
Low-molecular-weight heparin	156.12	38.22	111.09	70.21	45.27	18.92	89.16	30.81
Others	149.96	42.02	110.01	68.57	43.06	18.68	85.78	33.87
Subtotal	158.86	37.33	113.02	70.77	46.55	18.46	90.25	30.44
No description	158.49	39.25	110.78	70.64	46.31	19.56	91.31	31.77
Grand total	158.84	37.42	112.92	70.77	46.54	18.50	90.29	30.50

TABLE 35. *Number of patients (patient distribution) with respect to calcium concentration in dialysis solution*

	Less than 2.5	2.5–	2.75–	3.0–	3.5–	Subtotal	Others	No description	Grand total
Number of patients	3 565	59 245	11 514	94 779	1 839	170 942	472	35 415	206 829
(%)	(2.1)	(34.7)	(6.7)	(55.4)	(1.1)	(100.0)			

TABLE 36. *Mean concentrations of serum calcium, phosphorus and intact PTH prior to dialysis according to calcium concentration in dialysis solution*

	Serum calcium concentration prior to dialysis (mg/dL)		Serum calcium concentration prior to dialysis (mEq/dL)		Serum phosphorus concentration prior to dialysis (mg/dL)		Serum intact PTH concentration (pg/mL)	
Calcium concentration in dialysis solution	Average	Standard deviation	Average	Standard deviation	Average	Standard deviation	Average	Standard deviation
Less than 2.5	9.03	0.99	4.56	0.77	5.59	1.70	193.71	279.44
2.5–	9.07	0.99	5.16	1.62	5.64	1.58	207.47	225.97
2.75–	9.12	0.93	4.88	1.23	5.60	1.53	178.73	206.09
3.0–	9.12	0.96	5.48	1.87	5.47	1.67	171.13	216.21
3.5–	9.12	1.10	7.34	2.21	5.62	1.70	189.43	246.28
Subtotal	9.10	0.97	5.31	1.74	5.54	1.63	184.96	221.34
Others, undetermined	8.90	1.08	6.10	1.70	5.40	1.69	163.33	180.71
No description	9.04	1.09	6.15	2.04	5.52	1.78	185.64	214.61
Grand total	9.10	0.98	5.38	1.78	5.54	1.64	184.99	220.97

TABLE 37. *Types of anticoagulant used according to treatment method*

Treatment method	Heparin-type agents	Low-molecular-weight heparin	Protease inhibitor	Antithrombin	Sodium citrate	Others	Subtotal	No description	Grand total
Hemodialysis	138 973	32 939	3039	38	2	191	175 182	31 647	206 829
(%)	(79.3)	(18.8)	(1.7)	(0.0)	(0.0)	(0.1)	(100.0)		
Hemodiafiltration	8 682	2 740	262	1		13	11 698	2 034	13 732
(%)	(74.2)	(23.4)	(2.2)	(0.0)		(0.1)	(100.0)		
Hemofiltration	59	24	12				95	11	106
(%)	(62.1)	(25.3)	(12.6)				(100.0)		
Hemodiabsorption	314	98	9				421	63	484
(%)	(74.6)	(23.3)	(2.1)				(100.0)		
Home hemodialysis	41	21	1				63	14	77
(%)	(65.1)	(33.3)	(1.6)				(100.0)		
Total	148 069	35 822	3323	39	2	204	187 459	33 769	221 228
(%)	(79.0)	(19.1)	(1.8)	(0.0)	(0.0)	(0.1)	(100.0)		

Analysis 3: How to deal with decreased blood pressure

Table 45 shows the analysis results. No significant mortality risk was observed in patients not given the vasopressor therapy regardless of blood pressure at the end. With regards to the patients with blood pressure of less than 160 mm Hg at the end, the mortality risk for the vasopressor therapy-administered group was significantly higher than for the non-vasopressor therapy-administered group. When the mortality

TABLE 38. *Blood pressure at the start of dialysis vs. overall death risk*

Systolic blood pressure at the start of dialysis (mm Hg)	Hazard ratio	(95% confidence interval)	*P*-value
<100	1.817	(1.399–2.360)	<0.0001
100 < 120	1.495	(1.280–1.746)	<0.0001
120 < 140	1.122	(1.000–1.259)	0.0508
140 < 160	1.000	(Control)	Control
160 < 180	0.981	(0.881–1.091)	0.7176
>180	1.121	(0.992–1.266)	0.0674

TABLE 39. *Blood pressure at the greatest decrease vs. overall death risk*

Systolic blood pressure at the greatest decrease (mm Hg)	Hazard ratio	(95% confidence interval)	*P*-value
<80	1.650	(1.382–1.970)	<0.0001
80 < 100	1.516	(1.322–1.740)	<0.0001
100 < 120	1.138	(1.004–1.291)	0.0431
120 < 140	0.997	(0.880–1.128)	0.9576
140 < 160	1.000	(Control)	Control
160 < 180	1.260	(1.027–1.546)	0.0270
>180	1.339	(0.823–2.179)	0.2398

TABLE 40. *Blood pressure at the end of dialysis vs. overall death risk*

Systolic blood pressure at the end of dialysis (mm Hg)	Hazard ratio	(95% confidence interval)	*P*-value
<100	1.331	(1.121–1.579)	0.0011
100 < 120	1.101	(0.973–1.245)	0.1284
120 < 140	1.037	(0.935–1.151)	0.4910
140 < 160	1.000	(Control)	Control
160 < 180	0.961	(0.848–1.089)	0.5338
>180	1.113	(0.936–1.323)	0.2274

TABLE 41. *Vasopressor treatment during dialysis vs. overall death risk (all patients)*

Vasopressor treatment during dialysis	Hazard ratio	(95% confidence interval)	*P*-value
None	1.000	(Control)	Control
Oral and intravenous	1.420	(1.254–1.607)	<0.0001
Volume type	1.217	(1.100–1.345)	0.0001
Combined use	1.547	(1.345–1.779)	<0.0001

TABLE 42. *Vasopressor treatment during dialysis vs. overall death risk (Blood pressure at greatest decrease: less than 120 mm Hg)*

Vasopressor treatment	Hazard ratio	(95% confidence interval)	*P*-value during dialysis
None	1.000	(Control)	Control
Oral and intravenous	1.515	(1.291–1.777)	<0.0001
Volume type	1.329	(1.163–1.518)	<0.0001
Combined use	1.633	(1.377–1.936)	<0.0001

TABLE 43. *Vasopressor treatment during dialysis vs. overall death risk (Blood pressure at greatest decrease: 120–160 mm Hg)*

Vasopressor treatment	Hazard ratio	(95% confidence interval)	*P*-value during dialysis
None	1.000	(Control)	Control
Oral and intravenous	1.133	(0.904–1.421)	0.2777
Volume type	0.960	(0.801–1.150)	0.6585
Combined use	1.232	(0.916–1.656)	0.1674

TABLE 44. *Vasopressor treatment during dialysis vs. overall death risk (Blood pressure at greatest decrease: 160 mm Hg or higher)*

Vasopressor treatment	Hazard ratio	(95% confidence interval)	*P*-value during dialysis
None	1.000	(Control)	Control
Oral and intravenous	2.084	(1.091–3.981)	0.0263
Volume type	1.003	(0.547–1.838)	0.9934
Combined use	1.411	(0.500–3.985)	0.5151

TABLE 45. *Blood pressure at the end of dialysis and vasopressor treatment during dialysis vs. overall death risk*

Systolic blood pressure at the end of dialysis	Vasopressor treatment during dialysis	Hazard ratio	(95% confidence interval)	*P*-value
Less than 100 mm Hg	None	0.992	(0.735–1.337)	0.9556
Less than 100 mm Hg	Oral and intravenous	1.627	(1.128–2.346)	0.0091
Less than 100 mm Hg	Volume type	1.462	(1.079–1.983)	0.0144
Less than 100 mm Hg	Combined use	1.845	(1.279–2.661)	0.0011
100–120 mm Hg	None	0.905	(0.749–1.094)	0.3037
100–120 mm Hg	Oral and intravenous	1.636	(1.266–2.115)	0.0002
100–120 mm Hg	Volume type	1.056	(0.833–1.339)	0.6533
100–120 mm Hg	Combined use	1.573	(1.171–2.112)	0.0026
120–160 mm Hg	None	1.000	(Control)	Control
120–160 mm Hg	Oral and intravenous	1.355	(1.072–1.713)	0.0110
120–160 mm Hg	Volume type	1.377	(1.145–1.656)	0.0007
120–160 mm Hg	Combined use	1.569	(1.230–2.001)	0.0003
160 mm Hg or higher	None	0.957	(0.682–1.342)	0.7977
160 mm Hg or higher	Oral and intravenous	1.098	(0.639–1.887)	0.7340
160 mm Hg or higher	Volume type	1.222	(0.836–1.786)	0.3018
160 mm Hg or higher	Combined use	1.043	(0.552–1.970)	0.8976

Subjects analyzed: the systolic blood pressure of patients at the greatest decrease was less than 120 mmHg only.

risks of the vasopressor therapies were compared with the patient group with blood pressure of less than 160 mm Hg at the end, the highest risk was observed in the group receiving concomitant vasopressor therapies. This tendency was marked in the patient group with blood pressure of less than 100 mm Hg at the end. In the patient group with blood pressure of less than 120 mm Hg at the end, the mortality risk tended to be higher for the oral/intravenous vasopressor therapy-administered group than for the volume-type vasopressor therapy-administered group. With regards to the patient group with blood pressure higher than 160 mm Hg at the end, no significant mortality risk was observed for either vasopressor therapy group.

DISCUSSION—B. ANALYSES OF RELATIONSHIPS BETWEEN CHANGES IN BLOOD PRESSURE DURING DIALYSIS AND LIFE EXPECTANCY

Analysis 1: Relationships of blood pressures at the start, at the greatest decrease and at the end with vasopressor therapy and life expectancy

Significantly high mortality risks were observed for low blood pressures of 100 to less than 120 mm Hg at the start, at the end and at the greatest decrease. A higher mortality risk observed in the group with low blood pressure was reported (1). In the present analysis, an increased mortality risk for blood pressure of higher than 160 mm Hg either at the start or at the end was not necessarily clear. Previous reports showed that a high mortality risk was also observed for markedly high blood pressures, and these reports are not in agreement with the present findings.

Corrections were made for many factors (sex, age, years on dialysis, presence/absence of diabetes, bodyweight loss rate, Kt/V, serum albumin concentration, predialysis hematocrit, and dose of erythropoietin) in the present analyses of the relationships of blood pressures.

When the analysis was carried out with correction for only four factors, namely, sex, age, years on dialysis and presence/absence of diabetes, significantly high mortality risks were observed for blood pressures of higher than 180 mm Hg both at the start and at the end. When other corrected factors were added to this analysis model and when predialysis hematocrit and dose of erythropoietin were added, however, the significance of mortality risk of high blood pressure decreased markedly (data not shown). In view of the above, the present analysis showing that no significant mortality risk was observed for the patients with blood pressure of higher than 160 mm Hg either at the start or at the end might have been related to predialysis hematocrit or dose of erythropoietin in these patients.

The analyses of the relationships between the vasopressor therapies and life expectancy showed that the mortality risk for the non-vasopressor therapy-administered group was the lowest. These findings suggest the following two possibilities: One possibility is that 'carrying out no vasopressor therapy decreased mortality risk', and the other is that 'low-mortality-risk patients required no vasopressor therapy'. Patients whose blood pressure decreased markedly such that vasopressor therapy was required are considered to exhibit cardiac circulatory system function deterioration. If so, it might as well be considered that the above-mentioned latter possibility is

more likely. Nevertheless, it is difficult to conclude which of the above possibilities is true based on only the results of analysis 1.

The mortality risk for patients given vasopressor therapy was the highest for those concomitantly given oral/intravenous and volume-type vasopressor therapies. The mortality risks were high for the group given oral/intravenous vasopressor therapy and for the group given volume-type vasopressor therapy in this order following the group concomitantly administered. These results suggest the following two possibilities: One possibility is that 'the use of oral/intravenous-type vasopressor drugs involved a high mortality risk', and the other possibility is that 'oral/intravenous vasopressor drugs were used in high-mortality-risk patients. Again, it is difficult to conclude which of the above possibilities is true based on only the results of analysis 1.

Analysis 2: Relationships between vasopressor therapies and life expectancy analyzed according to blood pressure at the greatest decrease

The conditions regarding blood pressure at the greatest decrease were nearly the same among the patient groups classified by blood pressure at the greatest decrease. Thus, if mortality risk observed for the patient group given vasopressor therapy reflected only the risk for blood pressure at the greatest decrease, the mortality risks for vasopressor therapy calculated for the patient groups classified by blood pressure at the greatest decrease should be smaller than the mortality risk calculated for all the patients.

In the analysis of the patient group with blood pressure of 120 mm Hg or higher at the greatest decrease, no, or a very weak effect of vasopressor therapy on the prognosis of patients was observed. In the analysis of the patient group with blood pressure of less than 120 mm Hg at the greatest decrease, however, a very strong effect of vasopressor therapy on the patients' prognosis was observed, and the effect was stronger than that analyzed for all the patients.

The above results indicated that the risk of vasopressor therapy observed in analysis 1 was the concurrent risk caused by the vasopressor therapy itself and risk caused by the decreased blood pressure.

That is, the above analysis results suggest the possibility that if vasopressor therapy was carried out on patients with systolic blood pressure of less than 120 mm Hg, the vasopressor therapy would increase the mortality risk for these patients, in contrast to the expectation. It is expected that if vasopressor therapy was given to patients with a negligible decrease in systolic blood pressure, the mortality risk associated with the vasopressor therapy would not be augmented significantly.

Excessively decreased blood pressure causes circulatory failure of major organs, and this failure itself can be a fatal risk. This is supported by the results of analysis 1 which showed the significantly high mortality risk for the patients with blood pressure of less than 120 mm Hg at the end.

On the basis of the above results, it is still difficult to determine that in the event of decreased blood pressure during dialysis whether blood pressure at the end of dialysis should be raised by vasopressor therapy, or whether no vasopressor therapy should be carried out even when blood pressure at the end is slightly low.

Analysis 3: How to deal with decreased blood pressure

The results of analysis 3 suggest the possibility that when blood pressure decreases during dialysis, administering no vasopressor therapy will minimize a risk if it poses no problem despite slightly low blood pressure at the end.

Lynn compiled an overview of published work on the relationship between blood pressure and the prognosis of dialysis patients, and discussed as follows (7): 'Malnutrition is common in end-stage renal disease (ESRD) and is closely correlated with hypotension and poor survival. In many studies there are high rates of antihypertensive drug use, but treated and controlled blood pressure is treated similar to normal blood pressure in the survival analysis. The effect of hypertension on survival in the general population takes many years to be apparent. The duration of follow-up, if not long enough, might affect the results. In contrast, the poor prognosis of the primary disease might mask the detrimental effect of elevated blood pressure.' Suppose that patients given vasopressor drugs were those whose blood pressure could not be maintained without the use of a vasopressor because of cardiovascular complications and that patients given no vasopressors were those whose blood pressure could be maintained without using a vasopressor, the high mortality risk for patients for whom the vasopressor therapy/therapies was indicated as shown in the present study might be considered to support Lynn's discussion. This is because the short-term prognosis focusing on 1-year life expectancy was assessed in the present analysis. It is needless to say, however, that low blood pressure should not be left untreated if circulatory failure of major organs is detected.

As far as the patient group with blood pressure of less than 120 mm Hg at the end was concerned, the

volume-type vasopressor therapy tended to involve a lower mortality risk than the oral/intravenous vasopressor therapy. Nearly all the oral/intravenous vasopressors used in Japan have an activation effect on sympathetic nerve a and/or b receptors. The high mortality risk observed in patients given oral/intravenous vasopressor therapy might be the adverse effect of the sympathetic nerve activation induced by these vasopressor drugs. In cardiac failure patients, rather than dialysis patients, it was previously shown that sympathetic nerve activation correlated with an increased mortality risk (8), and this report is in agreement with the findings of the present analysis.

The present results suggest that frequently used oral/intravenous vasopressors can actually contribute to an increase in mortality risk regardless of blood pressure at the end.

The concomitant use of an oral/intravenous vasopressor and a volume- type vasopressor tended to involve a higher mortality risk than the use of only either one. This suggested that dialysis achieving only water removal by maintaining blood pressure artificially using many vasopressor drugs can potentially increase a mortality risk. The tendency toward an increased mortality risk in the 'concomitant' group was particularly notable in the group with low blood pressure at the end. Thus, caution should be exercised in using vasopressor therapy in dialysis patients in whom the use of a vasopressor fails to produce a sufficient increase in blood pressure.

Decreased blood pressure during dialysis is closely related to water removal during dialysis. The present analysis showed that although the effect of bodyweight loss rate on the prognosis of patients was adjusted, a significant correlation between changes in blood pressure during dialysis and life expectancy was still observed. This observation suggests that blood pressure and vasopressor therapy are factors independent of water removal during dialysis.

No significant mortality risk for vasopressor therapy was observed, irrespective of the type of vasopressor therapy in the patient group with blood pressure of higher than 160 mm Hg, at the end. A significantly high risk was observed in the vasopressor therapy-administered group, particularly for patients with blood pressure of less than 160 mm Hg at the end, as mentioned earlier; thus, the above results appear to be inconsistent. When the results of analysis 1 were reviewed, a significant risk was no longer observed in the patient group with blood pressure of higher than 160 mm Hg at the end. That is, the background underlying the absence of a significant risk in the patient group with blood pressure higher than 160 mm Hg at the end in analysis 3 might be the same as that for the patient group with blood pressure of higher than 160 mm Hg at the end in analysis 1. Unfortunately, it was impossible to clarify the details of the background on the basis of only the results of the present analysis.

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