

Status of Initiating Pattern of Hemodialysis: A Multi-center Study

This study was to evaluate the status of initiating pattern of hemodialysis (HD). Five hundred-three patients in 8 University Hospitals were included. Presentation mode (planned vs. unplanned), and access type (central venous catheters [CVC] vs. permanent access) at initiation of HD were evaluated, and the influence of predialysis care on determining the mode of HD and access type was also assessed. Most patients started unplanned HD (81.9%) and the most common initial access type was CVC (86.3%). The main reason for unplanned HD and high rate of CVC use was patient-related factors such as refusal of permanent access creation and failure to attend scheduled clinic appointments. Predialysis care was performed in 57.9% of patients and only 24.1% of these patients started planned HD and 18.9% used permanent accesses initially. Only a minority of patients initiated planned HD with permanent accesses in spite of predialysis care. To overcome this, efforts to improve the quality of predialysis care are needed.

Key Words : Renal Dialysis; Arteriovenous Fistula; Catheterization; Referral and Consultation

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INTRODUCTION

Placement of a vascular access is essential in patients who receive maintenance hemodialysis (HD). National Kidney Foundation-Dialysis Outcomes Quality Initiative Clinical Practice Guidelines for Vascular Access recommend placement of a permanent vascular access (arteriovenous fistulae [AVF] or arteriovenous grafts [AVG]) before initiation of maintenance HD to avoid the use of central venous catheters (CVC) (1). This is because permanent accesses provide better blood flow rates (2) and are associated with less complication than CVC (3-6). In addition, unplanned initiation of HD is associated with poorer outcomes than planned initiation (7). However, according to previous reports, roughly two thirds of patients initiate HD with CVC (8-10), although the use of permanent access increases over time (8), and a majority of patients go on unplanned HD at initiation (11-13).

For prior placement and use of a permanent access at initiation of HD, time is required for patient education, selection of dialysis modality, selection of the access type, surgical creation and maturation of the access. In this context, adequate time for predialysis care is essential. Previous studies have found that late referral to a nephrologist is a major determinant for use of CVC at initiation (8, 9, 14, 15) and is associated with poorer outcomes than early referral (7). We also found that late referral increased the risk of cardiovas-

cular disease-related mortality in HD patients (16). Therefore early referral is crucial for reducing the use of CVC and unplanned initiation of HD and improving outcomes.

Although there are a few reports of predialysis care and initial pattern of HD in Korea (14, 15), they were data from a single center. In addition, Asian data about the type of access in use and mode of presentation (unplanned vs. planned) in patients initiating HD are scarce. According to the database of the end-stage renal disease registry committee in Korean Society of Nephrology, the prevalence of end-stage renal disease (ESRD) is increasing rapidly, and the number of HD patients accounts for three fourths of patients on dialysis therapy (17). Thus we undertook a multi-center study to investigate the type of access, presentation mode of the first HD and the significance of care by a nephrologist in initial pattern of HD and 6 month-mortality.

MATERIALS AND METHODS

Study design and population

A retrospective, multi-center study was conducted of patients with ESRD starting maintenance HD between January 2006 and June 2007, at dialysis centers of 8 hospitals of the Catholic University of Korea. The centers were located in 6

cities of 4 provinces; Seoul, Gyeonggi-do (Uijeongbu, Suwon, and Bucheon), Incheon, and Daejeon. Patients undergoing HD because of acute kidney injury were excluded.

Five hundred-three patients started HD between the study period. Most of patients were located in Seoul city (Seoul; n=211, Uijeongbu; n=128, Suwon; n=58, Bucheon; n=45, Incheon; n=23, and Daejeon; n=38). Demographic characteristics are shown in Table 1. The most common cause of renal failure was diabetes, and most of patients had co-morbidities, such as hypertension and cardiovascular diseases. The median estimated glomerular filtration rate (eGFR) at initiation of HD was 6.6 mL/min/1.73 m² (range, 1.2-47.1 mL/min/1.73 m²). Laboratory values at initiation of HD are shown in Table 2.

Definitions

In this study, predialysis care refers to outpatient care rendered by a nephrologist in a dedicated clinic for chronic kidney disease (CKD) for at least 3 months prior to starting HD, which is consistent with our (16) and other reports (7, 12). Unplanned initiation of HD refers to starting HD without prior placement of a permanent access, and planned initiation of HD refers to starting HD with prior placement of a permanent access, regardless of whether the access is functional. CVC refers to either tunneled cuffed catheter (TCC) or non-cuffed catheter (NCC). Of reasons for using CVC initially, patient-related factors include no show, refusal of surgery, and change in modality from peritoneal dialysis (PD) to HD.

Table 1. Patient characteristics (n=503)

	Patients (n)
Age* (yr)	59 (16-93)
Male (%)	268 (53.3)
Primary cause of renal failure (%)	
Diabetes	261 (51.9)
Hypertension	93 (18.5)
Chronic glomerulonephritis	66 (13.1)
Chronic tubulointerstitial disease	10 (2.0)
Polycystic kidney disease	7 (1.4)
Others	66 (13.1)
Co-morbidities (%)	
Hypertension	412 (81.9)
Cerebrovascular disease	59 (11.7)
Cardiac disease	91 (18.1)
Ischemic heart disease	43
Heart failure	28
Ischemic heart disease and heart failure	7
Others	13
Predialysis care (%)	
Never seen or seen in a CKD clinic <3 months	212 (42.1)
Seen in a CKD clinic 3-11 months	95 (18.9)
Seen in a CKD clinic ≥ 12 months	196 (39.0)

*, Expressed as a mean value.
CKD, chronic kidney disease.

No show refers to failure to attend scheduled clinic appointments for at least 3 months, refusal of surgery refers to refusal to create a permanent access prior to start of HD, and change in modality from PD to HD refers to switch of modality from PD to HD in patients who were on PD before. Acute need for dialysis was defined as unexpected need for dialysis because of rapid loss of glomerular filtration rate (GFR) or development of severe uremic complications, such as uremia, pulmonary edema with hypoxia, hyperkalemia or metabolic acidosis. As Lenz et al. (18) defined in their report, rapid GFR loss refers to sudden drop in GFR that deviated from declining rate observed in preceding months. Poor maturation of the access refers to immature access despite at least 8 weeks of maturation. Physician-related factors include delay in referral to a surgeon and delay between referral and surgery. Delay in referral to a surgeon is delay by a nephrologist, although the patient has selected the modality of dialysis, and it refers to more than 4 weeks of interval between selection of modality and referral to a surgeon by a nephrologist. As Mendelssohn et al. (19) reported that the shortest average time from access referral to creation was 16 days, delay between referral and surgery was defined as more than 3 weeks of delay between referral to a surgeon and access creation. Planning renal transplantation refers to a schedule to receive renal transplantation within 3 months after start of HD.

Data collection

The following data were collected from patient medical records; patient demographics, laboratory values at initiation of HD, predialysis care, presentation mode of initial HD (unplanned vs. planned), reasons for unplanned HD, type of

Table 2. Laboratory values at initiation of HD (n=503)

	Mean ± SD (range)
Hemoglobin (g/dL)	8.6 ± 1.8 (3.5-16.2)
Hematocrit (%)	25.5 ± 5.3 (10.1-51.6)
Urea nitrogen (mg/dL)	95.9 ± 39.6 (17.6-26.5)
Creatinine (mg/dL)	8.7 ± 4.3 (1.5-33.0)
Total protein (g/dL)	6.1 ± 0.9 (3.4-4.3)
Albumin (g/dL)	3.3 ± 0.6 (1.5-4.9)
Calcium (mg/dL)	7.7 ± 1.0 (4.0-11.3)
Phosphate (mg/dL)	6.2 ± 2.1 (1.4-15.0)
Uric acid (mg/dL)	8.3 ± 2.5 (2.2-17.8)
Sodium (mEq/L)	136.6 ± 5.4 (114.0-166.0)
Potassium (mEq/L)	5.0 ± 1.1 (2.4-8.5)

Values are expressed as mean ± SD. To convert hemoglobin in g/dL to g/L, multiply by 10; urea nitrogen in mg/dL to mM/L, multiply by 0.357; creatinine in mg/dL to μM/L, multiply by 88.4; total protein in g/dL to g/L, multiply by 10; albumin in g/dL to g/L, multiply by 10; calcium in mg/dL to mM/L, multiply by 0.2495; phosphate in mg/dL to mM/L, multiply by 0.3229; uric acid in mg/dL to μM/L, multiply by 59.48; sodium in mEq/L to mM/L, multiply by 1; potassium in mEq/L to mM/L, multiply by 1. HD, hemodialysis.

access in use at initiation and at 6 months after the first HD, reasons for using CVC initially, and deaths within 6 months. eGFR was determined by serum creatinine concentration, age, gender, and race using the abbreviated Modification of Diet in Renal Disease formula (MDRD-GFR) (20).

Statistical analysis

Continuous data were computed by median or mean ± standard deviation (SD) and were compared using independent t-test. Categorical variables were compared using chi-square test. Multivariate logistic regression analysis was used to estimate independent predictors of deaths within 6 months after initiating HD. Included variables were age, gender, presence of diabetes and cardiac and cerebrovascular disease, predialysis care, presentation mode of initial HD, and the first access type in use. The estimated standard error of the coefficient (B1) was used to establish confidence intervals (CI) of odds ratio (OR).

RESULTS

Unplanned initiation vs. planned initiation

Four hundred-twelve patients (81.9%) underwent unplanned initiation of HD, while 91 patients (18.1%) underwent planned initiation. Reasons for unplanned dialysis were col-

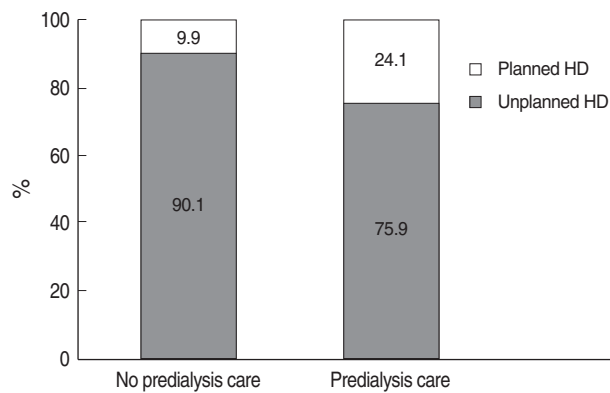


Fig. 1. Rate of planned HD. The proportion of patients who started planned HD was higher in patients with predialysis care than in patients without predialysis care (24.1% vs. 9.9%, *p*<0.001).

lected in 333 patients. The leading one was uremia (n=182, 54.7%), and the followings were pulmonary edema with hypoxia (n=93, 27.9%), hyperkalemia (n=18, 5.4%), metabolic acidosis (n=10, 3.0%), combined reasons (n=18, 5.4%), and other reasons (n=12, 3.6%). The rate of planned HD in each center is listed in Table 3. The rate differed between centers, ranging from 4.4% to 42.9%.

Type of vascular access at initiation of HD

At initiation of HD, only 69 patients (13.7%) were using permanent accesses; 56 patients (11.1%) using AVF and 13 patients (2.6%) using AVG. Four hundred and thirty-four patients (86.3%) were using CVC; 263 patients (52.3%) using NCC and 171 patients (34.0%) using TCC. The rate of initial use of permanent access is listed in Table 3. The rate differed between centers, ranging from 4.4% to 40.0%.

Of 91 patients who started planned HD with prior placement of a permanent access, 22 patients (24.2%) used CVC initially, and the mean interval between access placement and CVC insertion was 3.4 ± 3.9 weeks (range, 1-15 weeks). In contrast, 69 patients (75.8%) used permanent accesses initially, and the mean interval between access placement and the first cannulation was 16.8 ± 20.8 weeks (range, 2 weeks-30 months) (*p*<0.001).

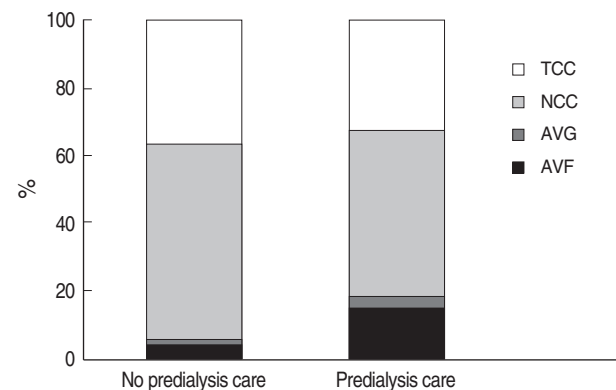


Fig. 2. Type of vascular access in use at initiation of HD. Patients who received predialysis care used more permanent accesses than those who did not receive predialysis care (18.9% vs. 6.6%, *p*<0.001) at initiation of HD. TCC, tunneled cuffed catheter; NCC, non-cuffed catheter; AVG, arteriovenous grafts; AVF, arteriovenous fistulae.

Table 3. Rate of planned HD, initial use of permanent access and predialysis care in each center

Center	A	B	C	D	E	F	G	H	<i>p</i>
Planned HD (%)	15.7	15.8	8.7	4.4	17.4	31.0	42.9	15.6	<0.001
Initial use of permanent access (%)	11.8	15.8	8.7	4.4	13.0	17.2	40.0	10.9	<0.001
Predialysis care of all patients (%)	59.5	52.6	39.1	53.3	69.6	60.3	68.6	56.3	0.379
Predialysis care of diabetic patients (%)	55.4	63.6	50.0	56.0	58.3	60.0	72.2	60.3	0.924

Alphabet A-H represents each dialysis center included in this study. HD, hemodialysis.

Table 4. Reasons for starting HD with CVC according to the presentation mode (n=434)

	Unplanned HD n=412 n (%)	Planned HD n=22 n (%)	Total n=434 n (%)
Patient-related factors	227 (55.1)	0 (0)	227 (52.3)
No show	47	0	47
Refusal of surgery	151	0	151
Change in modality from PD to HD	29	0	29
Acute need of dialysis	107 (26.0)	5 (22.7)	112 (25.8)
Absence of predialysis care	53 (12.9)	2 (9.1)	55 (12.7)
Poor maturation of the access	0 (0)	5 (22.7)	5 (1.2)
Physician-related factors	17 (4.1)	10 (45.5)	27 (6.2)
Delay in referral to a surgeon	12	5	17
Delay between referral and surgery	5	5	10
Planning renal transplantation	6 (1.5)	0 (0)	6 (1.4)
Unknown	2 (0.5)	0 (0)	2 (0.5)

No show, failure to attend scheduled clinic appointments for at least 3 months; Refusal of surgery, refusal to create a permanent access prior to start of HD; Change in modality from PD to HD, switch of modality from PD to HD in patients who were on PD before; Acute need of dialysis, unexpected need of dialysis because of rapid loss of GFR or development of severe uremic complications, such as uremia, pulmonary edema with hypoxia, hyperkalemia or metabolic acidosis; Rapid GFR loss, sudden drop in GFR that deviated from declining rate observed in preceding months; Poor maturation of the access, immature access despite at least 8 weeks of maturation; Delay in referral to a surgeon, more than 4 weeks of interval between selection of modality and referral to a surgeon by a nephrologist; Delay between referral and surgery, at least 3 weeks of delay between referral to a surgeon and access creation; Planning renal transplantation, a schedule to receive renal transplantation within 3 months after start of HD.

HD, hemodialysis; CVC, central venous catheter; PD, peritoneal dialysis.

Effect of predialysis care on presentation mode and initial access type

As shown in Table 1, patients who received predialysis care were 291 (57.9%), and those who did not receive predialysis care were 212 (42.1%). Of patients with predialysis care, 95 patients (32.6%) received less than 12 months of predialysis care, and 196 patients (67.4%) received at least 12 months of care. Of patients without predialysis care, information on previous medical care was collected in 192 patients. Seventy-three patients (38.0%) were seen by primary care physicians, 28 (14.6%) by endocrinologists, 13 (6.8%) by cardiologists, 39 (20.3%) in other departments, and 39 (20.3%) did not have any medical care before. Of patients with diabetic nephropathy, 107 patients (41.0%) did not receive predialysis care. Forty-five patients (42.1%) were seen by primary care physicians, 25 (23.4%) by endocrinologists, and 8 (7.5%) by cardiologists. The rate of predialysis care of patients with diabetic nephropathy did not differ between centers (Table 3).

Table 5. Multivariate logistic regression analysis of predictors of deaths within 6 month after initiation of HD

	OR	p	95% CI	
			Lower	Upper
Age (per year)	1.05	0.001	1.02	1.09
Diabetes	0.45	0.5	0.20	1.01
Cardiac disease	3.32	0.004	1.46	7.55
Cerebrovascular disease	4.51	0.002	1.75	11.60
Absence of predialysis care	1.50	0.3	0.69	3.28
Unplanned initiation	1.57	0.7	0.18	13.92
CVC use at initiation	0.66	0.7	0.06	6.10

HD, hemodialysis; OR, odds ratio; CI, confidence interval; CVC, central venous catheter.

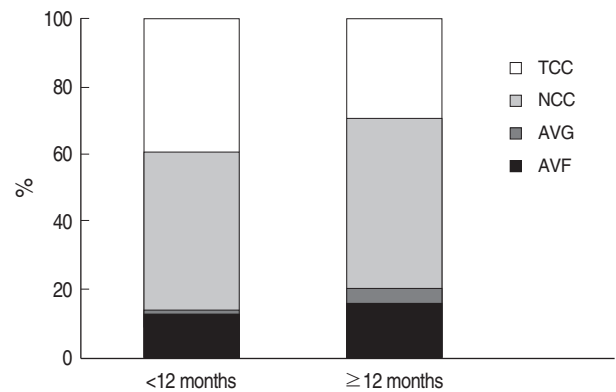


Fig. 3. Type of vascular access in use at initiation of HD according to the duration of predialysis care. Patients who received 12 months or more of predialysis care tended to use more permanent accesses than those who received less than 12 months of predialysis care (20.6% vs. 14.7%, $p=0.2$).

TCC, tunneled cuffed catheter; NCC, non-cuffed catheter; AVG, arteriovenous grafts; AVF, arteriovenous fistulae.

The proportion of patients who started planned HD was higher in patients with predialysis care than in patients without predialysis care (24.1% vs. 9.9%, $p<0.001$, Fig. 1). The proportion of patients who used permanent accesses at initiation of HD was higher in patients with predialysis care than in patients without predialysis care (18.9% vs. 6.6%, $p<0.001$, Fig. 2). Of patients with predialysis care (n=291), patients who received 12 months or more of care tended to use more permanent accesses than those who received less than 12 months of care, but there was no statistical difference (20.6% vs. 14.7%, $p=0.2$, Fig. 3).

Comparison of CVC use between planned HD and unplanned HD

Reasons for CVC use differed by the presentation mode of initial HD (Table 4). In patients with unplanned HD, the three most common reasons for using CVC were patient-related factors (55.1%), acute need for dialysis (26.0%), and absence of predialysis care (12.9%). In contrast, in patients

with planned HD, major reasons were physician-related factors (45.5%), acute need for dialysis (22.7%), and poor maturation of the access (22.7%). Of physician-related factors (n=10), 5 were delay in referral to a surgeon, and 5 were delay between referral and surgery.

Change in type of vascular access at 6 months after initiation of HD

Type of access in use at 6 months after initiation of HD was assessed after excluding patients who were on PD (n=57), who received renal transplantation (n=25), or who were lost for follow-up (n=71). Of 350 patients, 252 patients (72.0%) were using AVE, 54 (15.4%) using CVC, and 44 (12.6%) using AVG.

Influence of initial access type and predialysis care on deaths within 6 months

Mortality rate within 6 months after initiation of HD was 10.5% (n=36), after excluding patients who were on PD (n=57), received renal transplantation (n=25), or were lost for follow-up (n=77). In the multivariate logistic regression analysis, independent factors associated with deaths within 6 months were age (OR 1.05 per year, 95% CI 1.02-1.09) and the presence of cardiac disease (OR 3.32, 95% CI 1.46-7.55) and cerebrovascular disease (OR 4.51, 95% CI 1.75-11.60) (Table 5). Neither the absence of predialysis care, unplanned initiation, nor the initial CVC use was a risk factor predicting deaths within 6 months.

DISCUSSION

Our study shows the discrepancy between clinical practice and recommendations by guidelines in initiation of maintenance HD. Most patients initiated HD in an unplanned manner, without prior creation of a permanent access, and used CVC as their first access. More patients who received at least 3 months of care by a nephrologist started HD in a planned manner, with prior creation of a permanent access, and more used a permanent access than those referred later. Nevertheless, only a minority of patients with predialysis care initiated planned HD with permanent accesses. This is the first multi-center report of how patients prepare and start HD in Asia including Korea, and it is not just a problem of a facility as it was conducted from a cohort of 8 hospitals in 4 provinces. Furthermore, the results demonstrate the clinical implication of predialysis care in preparing HD in practice.

Although the use of permanent access increases over time (8), most patients use CVC at initiation of HD. Lenz *et al.* (18) reported the incidence of initial CVC use to be 92.3%, Astor *et al.* (10) and Stehman-Breen *et al.* (9) to be about

66%. In our cohort, the proportion of patients who started HD in an unplanned manner (81.9%) and that of patients who used CVC as their first access (86.3%) were both higher than other reports (7, 9, 10). The higher frequency may be explained by two reasons. One reason is the difference in population. While most studies excluded patients who were to enter PD therapy and who were to receive or who previously received renal transplantation, there were 82 patients (16.3%) in those categories included in our study. We included patients who changed to PD or renal transplantation because many patients start HD without choosing their dialysis modality in clinical practice. The second reason is that the definition of planned initiation of HD differed from other reports. Lorenzo *et al.* (7) defined planned initiation as more than 3 months of care by a nephrologist before starting HD, and Marrón *et al.* (12) defined it as outpatient, scheduled initiation. Our definition of planned initiation was starting HD with prior placement of a permanent access, regardless of whether the access is functional. This was because we considered the creation of a permanent access is the most crucial and difficult step in planning and preparing HD. Other multiple reasons may be attributable, such as center-specific guidelines, coexisting diseases, and hemodynamic status. However, even considering the difference, this higher rate reflects that our clinical practice is far from what guidelines recommend, which was consistent with other studies (7-13, 18, 21).

As shown in Table 4, the most common reasons for CVC use were patient-related factors. This shows that the patient's reluctance is the major barrier of access planning in our clinical practice. Our result is different from results by Lenz *et al.* (16), in which the most common reasons were inadequate predialysis care. There are three explanations for the higher proportion of patient-related factors than the absence of predialysis care in our results. First, the definition of patient-related factors was less strict than that of other study (18). In our study, no show was defined as failure to attend scheduled clinic appointments for at least 3 months, in contrast other study (18) defined it as failure to attend at least half of scheduled appointments. Second, 'absence of predialysis care' was judged to be responsible only when the patient had no obvious reasons other than the absence of predialysis care. Third, the proportion of patients who refused surgery for vascular access was higher in our cohort than in the cohort by Lenz *et al.* (18). In our result, refusal of surgery accounted for 34.8% of total CVC users (n=434). In contrast, in the cohort by Lenz *et al.* (18), it accounted for only 1.9% of total CVC users (n=157).

The presence of predialysis care was an important factor in determining both the mode of presentation and initial access type. Thus early referral to a nephrologist is indeed essential for increasing numbers of patients initiating planned HD and using permanent accesses (8, 9, 11-15, 18, 22). However, there are two considerable aspects in our study. One is the quality of predialysis care. It is remarkable that despite

more than 3 months of care by a nephrologist, most patients started unplanned HD (75.9%) and used CVC initially (81.1%). In our study, the proportion of predialysis care was similar between centers. But the rate of planned HD and use of permanent access differed between centers, ranging from 4% to 43% (Table 3). This indicates that the quality of predialysis care differed between centers. Dialysis education by nephrologists and HD nurses and frequent medical visits can influence the timing and planning of HD (11, 12, 23), and efforts of physicians for vein preservation and preoperative vein mapping can influence the choice of access type (24). Thus a multidisciplinary team-based care is suggested to improve the quality of predialysis care, which incorporates nephrologists, nurses, dieticians and social workers (19, 25, 26). Another aspect is the definition of early referral. As the economical burden of the insurance system and concept of dialysis differ between countries, the accurate time for early referral is difficult to estimate. However, we should consider factors that are out of our control, such as acute need for dialysis, rapid GFR loss or poor maturation of the access, which accounted a substantial portion of reasons for CVC use in our study (Table 4). Buck et al. (11) reported that service-related factors were responsible for urgent initiation of HD among patients who had been seen by a nephrologist at least 4 months, including delayed discussion and counseling by HD nurses and late referral for access creation. Lenz et al. (18) found that there were patient-related factors, physician-related factors and unexpected reasons for CVC use despite at least 4 months of predialysis care. To overcome these problems, 3-4 months may be insufficient for adequate predialysis care, and from our results, the optimal period for predialysis care seems to be more than 3 months. Some authors suggested it has to be at least 12 months (11, 27, 28). Although a statistical significance was not achieved, patients with predialysis care at least 12 months tended to use more permanent accesses at initiation than patients with predialysis care less than 12 months in this study (Fig. 3). To determine the adequate length of time for predialysis care, further study is required.

The time of permanent access placement is also of importance in determining the access type at initiation. In our study, about a quarter of patients who had prior access placement used CVC as their first access, and the interval between access placement and initial HD was significantly shorter in CVC users than in permanent access users (3.4 ± 3.9 weeks vs. 16.8 ± 20.8 weeks). This indicates that delay in creating a permanent access was a significant contributor for CVC use even in patients who had prior access placement. As shown in Table 4, acute need for dialysis (22.7%), poor maturation of the access (22.7%), delay in referral to a surgeon (22.7%) and delay between referral and surgery (22.7%) accounted most reasons for CVC use. In addition, of patients who did not have prior access placement, one third used CVC because of acute need for dialysis (26.0%), delay in referral to a sur-

geon (2.9%) and delay between referral and surgery (1.2%). If delays in access creation had been reduced, the frequent CVC use could have been reduced in 32.0% of the entire CVC users.

The encouraging part in our study is that, although a minority of patients used permanent accesses at their first HD, most (84.6%) changed to permanent accesses after 6 months and that AVF was the leading type in use (72%). This rate is higher than that of United States or Canada (8, 19, 21, 29), but lower than those of several countries in Europe (21). This indicates that a facility's preference and approaches to choice of access differ between countries and determine the access type in use. Therefore efforts to meet the goal for CVC use to <10% (1) can further increase the AVF use.

Contrary to our expectation, neither the absence of predialysis care, unplanned initiation, nor initial CVC use was a risk predicting deaths within 6 months (Table 5). This result differs from other reports which show the independent contribution of care by a nephrologist (8, 22) and the type of access (7, 10, 27, 30-32) in determining the patient outcome. Our result can be explained by two reasons. First, the follow-up period of 6 months may have been relatively short to assess the long-term survival. If the follow-up period were extended longer, there may be difference in mortality between the access types as other studies (7, 8, 15). Second, the overuse and imprudent preference to CVC of nephrologists ourselves may have made no difference in mortality rate.

In conclusion, most patients initiated unplanned HD and used CVC initially, in spite of predialysis care. To reduce the use of CVC in patients initiating HD, early referral for predialysis care, access planning, and timely attempts for creation of a permanent access is essential.

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