

Original Article

Prevalence of Cognitive Impairment Among Elderly Chinese Continuous Ambulatory Peritoneal Dialysis Patients

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Objective: To determine the prevalence and attributes of cognitive impairment in elderly continuous ambulatory peritoneal dialysis (CAPD) patients.

Methods: The Cantonese version of the Mini-Mental State Examination (CMMSE) was used to assess the cognitive function of 81 elderly CAPD patients and 66 healthy elderly (age ≥ 65 years). The maximum score is 30, with a higher score indicating better cognitive performance. Other study variables included demographic data, duration of dialysis, dialysis adequacy (Kt/V), albumin and hemoglobin levels, comorbid medical conditions, days of hospital stay, and episodes of peritonitis and exit site infection.

Results: The CAPD group had lower CMMSE scores than the healthy elderly group ($p < 0.001$); 32.1% of CAPD patients and 7.6% of the healthy elderly were identified as cognitively impaired according to CMMSE cutoff points ($p < 0.001$). Logistic regression revealed that increased age (odds ratio, OR, 1.1; 95% confidence interval, 95% CI, 1.02–1.3; $p = 0.018$) and female gender (OR, 3.3; 95% CI, 1.1–9.9; $p < 0.03$) were significantly and positively associated with cognitive impairment. Protective factors included years of education (OR, 0.78; 95% CI, 0.65–0.94; $p < 0.009$). After adjusting for the effects of age, gender and education, CAPD patients were at greater risk for cognitive impairment than the healthy elderly (OR, 7.7; 95% CI, 2.4–24.8; $p < 0.001$). Education was positively correlated with CMMSE score ($r = 0.52$; $p < 0.001$), while days of hospital stay showed an inverse relationship ($r = -0.243$; $p = 0.03$). The duration of dialysis, Kt/V, albumin and hemoglobin levels, and the number of comorbid conditions were not correlated with CMMSE score.

Conclusion: There is a high prevalence of cognitive impairment in elderly CAPD patients. It is imperative that a cognitive screening test be incorporated into nursing assessments for early detection of cognitive changes. [*Hong Kong J Nephrol* 2004;6(1):22–30]

Key words: cognitive impairment, Cantonese version of the Mini-Mental State Examination, CMMSE, continuous ambulatory peritoneal dialysis, CAPD

目的：評估認知能力受損在年長的連續性可攜帶腹膜透析病者 (CAPD) 中的發病率及瞭解其可能導致認知能力受損的因由。

方法：以廣東語簡短智能測試問卷 (CMMSE) 去評估 81 位 CAPD 長者和 66 位健康長者的認知能力。其他研究變數包括：個人及生活狀況，透析累積月數，血色數，Kt/V，血液中蛋白質，共存之疾病，住院日數，腹膜炎與導管出口發炎次數。

結果：CAPD 長者的 CMMSE 分數比健康長者為低 ($p < 0.001$)。32.1% CAPD 長者和 7.6% 健康長者被界定為認知能力受損 ($p < 0.001$)。年歲增長及婦女具有危險因素。年歲增長 (odds ratio, OR, 1.1; 95% confidence interval, 95% CI, 1.02–1.3; $p = 0.018$)；婦女 (OR, 3.3; 95% CI, 1.1–9.9; $p < 0.03$)。求學年數則具有利好因素 (OR, 0.78; 95% CI, 0.65–0.94; $p < 0.009$)。經過調較因受年歲增長，性別及求學年數的因素影響後，CAPD 長者比健康長者多七成機會有認知能力受損 (OR, 7.7; 95% CI, 2.4–24.8, $p < 0.001$)。CMMSE 分數與求學年數有正面之相關 ($r = 0.52$, $p < 0.001$) 而與住院日數則有

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反面之相關 ($r = -0.243, p = 0.03$)。透析累積月數，血色數， K_t/V ，血液中蛋白質及共存之疾病變數與 CMMSE 分數則沒有相關。

結果：研究發現年長的連續性可攜帶腹膜透析病者有很高的認知能力受損發病率。簡短智能測試應納入護理評估中以能及早察覺減退的認知能力。

INTRODUCTION

Over the past decade, global aging has become an important issue in health care planning because of its impact on medical and socioeconomic systems. Renal replacement therapy (RRT) is part of current geriatric medicine [1]. More than 82% of end-stage renal disease (ESRD) patients receiving RRT in Hong Kong are over the age of 60 years [2]. Cognitive impairment might not have received attention from dialysis professionals in the past, as most ESRD patients did not live long enough for the symptoms of cognitive impairment to become evident. Moreover, physical incapacity can easily be observed, but diminished cognitive function is usually neglected and therefore attracts little attention. It is foreseeable that patients on dialysis will experience deterioration in their physical and cognitive function over time. The cognitive decline could have a great impact on the self-care of continuous ambulatory peritoneal dialysis (CAPD) patients who require both technical skills and intellectual reasoning to manage their treatment. At present, periodic assessment of cognitive function is uncommon in the dialysis community.

This paper aims specifically to determine the prevalence of cognitive impairment in elderly Chinese CAPD patients in Hong Kong. The possible attributes of cognitive impairment in dialysis patients and the possible impact of cognitive impairment on their health outcomes are examined. The focus of concern is the direction of care in the aging dialysis community.

METHODS

This was a cross-sectional descriptive study. The adequacy of the sample size was estimated to be 64 participants in each group, giving an alpha of 0.05, a power of 0.8, and a medium effect size of 0.5 [3]. Data collection and assessment of cognitive function were carried out between August 2001 and January 2002.

Characteristics of subjects and sampling venues

All participants were ethnic Chinese aged at least 65 years. Their native language was Cantonese. CAPD participants were recruited from the renal unit of a major hospital in the Yau Tsim Mong district of Hong Kong,

and a group of healthy elderly subjects was recruited from two local geriatric community centers in the Kwai Tsing district for comparison. The two designated districts are both in the Kowloon region and have similar age distributions. People over 65 years of age account for 13% of the population in Yau Tsim Mong and 11% in Kwai Tsing, where the median ages are 38 and 36 years, respectively [4].

The healthy elderly had no chronic diseases such as hypertension, diabetes, heart disease, lung disease and mental illness. They also had no history of cerebral vascular accidents or head injuries that required surgery. They could not be taking any regular prescriptions, but health food supplements bought over the counter were acceptable. All healthy subjects attended a health check-up program organized by the community centers prior to an invitation to a cognitive function assessment. The healthy elderly were interviewed by the principal investigator. A medical history was obtained to rule out the presence of any chronic illness. Participants with a blood pressure of more than 160/100 mmHg or with positive findings of proteinuria and glucosuria were excluded.

The target group included all CAPD patients aged 65 years and older who had received maintenance peritoneal dialysis therapy for at least 6 months. All participants were interviewed during their scheduled outpatient clinic visits. None of the participants were in any acute physical or emotional distress during the interview. Special attention was paid to identify patients with depression, which might affect cognitive performance. Patients who presented with classical signs of depression, such as apathy, lack of interest in the environment, and refusal to eat, drink and follow a prescribed treatment regimen [5], were rescheduled for another interview or excluded from the study. Patients with severe hearing and speech deficits were also excluded.

Assessment of cognitive function

The Cantonese Mini-Mental State Examination (CMMSE) was used to assess cognitive function [6]. The CMMSE was translated from the modified version of the Mini-Mental State Examination (MMSE) [7]. Direct translation of the MMSE from English into Cantonese was successful for most questions. Other items were rephrased using culturally appropriate

wording so that the instrument became more colloquial to the Hong Kong elderly [6].

The CMMSE is a short questionnaire consisting of 30 questions assessing six domains of cognitive function: orientation for time and place (10 points), registration (3 points), attention and calculation (5 points), recall (3 points), language and ability to follow simple verbal and written commands (8 points), and copying a figure (1 point). Each correct answer is credited with 1 point to give a maximum score of 30 points; a higher score indicates better cognitive performance. The cutoff points for detection of cognitive impairment in this study were adopted from a more extensive local study in which the effect of education was evaluated [8]. Cognitive function is identified as impaired when the CMMSE score is 18 or below for illiterate patients, 20 or below for subjects with 1–2 years of schooling, and 22 or below for those with more than 2 years of schooling.

Prior to the start of the study, the principal investigator participated in three practical sessions to learn CMMSE administrative skills. One session was scheduled to observe how the psycho-geriatric outreach nursing team from the Kwai Chung Psychiatric Hospital conducted the CMMSE for the elderly at a community center. Two other sessions were scheduled to practice administration of the CMMSE to a group of elderly in the center. All practice sessions were under the supervision of an experienced social worker who later gave feedback and approval for the administration of the CMMSE. The CMMSE assessment took about 15–20 minutes. Interviews were conducted in a private room to minimize distractions and disturbances. The principal investigator was the only interviewer in this study. Therefore, variation in questionnaire administration was reduced to a minimum.

Data collection for demographic and study variables

Demographic data including age, gender, years of education, living arrangements, marital status and family income were collected from all participants. Clinical data from the CAPD group included the duration of CAPD therapy (months), dialysis adequacy index (Kt/V), serum albumin (g/L) and hemoglobin (g/dL) level, and previous history of medical comorbidities such as hypertension, diabetes mellitus, cerebral vascular disease, ischemic heart disease, coronary heart disease (CHD), peripheral vascular disease, malignancy, thyroid disease, psychiatric illness, and hepatitis B and C. Data collection for health care outcomes was retrospective for the 6 months before the CMMSE assessment. Data retrieval included length of hospitalization (days) and episodes of exit site infection and peritonitis. Additional data were collected from the CAPD group regarding the care provider for dialysis

therapy, categorized as self-care or helper, including relatives, domestic helpers and institutional staff. The level of dependence in daily activities was recorded from self report, categorized as independent, partially dependent or dependent. Independent referred to patients who could manage all their daily activities including CAPD therapy. Partially dependent patients required assistance in some of their daily activities including CAPD therapy. Dependent referred to patients who were totally dependent on others for their daily life routines that included feeding, bathing, toileting, and CAPD therapy.

Ethical issues

Approval of the study was obtained from the hospital ethics committee and from the two community centers. The purpose of the study was explained and all participants retained the right to terminate the interview. Informed signed consent was obtained from all participants and from accompanying family members prior to the assessment. Confidentiality was assured. Only the principal investigator or people involved in the study had access to the data files.

Statistical analysis

Data were analyzed using SPSS version 10.0 (SPSS Inc, Chicago, IL, USA) for Windows. All statistical tests were two tailed. The CMMSE scores in the two study groups were compared using the Mann-Whitney U test as normal distribution of data was not assumed. The level of cognitive function was classified as either normal or impaired according to the CMMSE cutoff points [8]. The independent *t* test and the Chi-squared test were used to compare continuous and categorical demographic variables between the CAPD and healthy groups. Correlation coefficients were calculated to determine the relationship between the CMMSE score and predictor variables. Univariate descriptive statistical analysis was used to demonstrate the distribution of social and clinical characteristics in the CAPD group. All significant associations with a *p* of less than 0.05 were analyzed by logistic regression to determine the variables that could best predict the occurrence of cognitive impairment.

RESULTS

Demographic distribution and prevalence of cognitive impairment

Three CAPD patients were excluded from the target CAPD patients in the designated renal unit: one had a history of severe dementia and so was unable to participate in the study, one's native language was Japanese, and one had a severe hearing deficit despite the use of a hearing aid. One CAPD patient who presented signs of apathy at the start of the first cognitive assessment

was rescheduled for another interview 3 months later; the second interview was uneventful. There were 147 participants, 81 CAPD patients (40 females and 41 males) and 66 healthy elderly (35 females and 31 males). There was no significant difference in demographic data including age, gender, marital status and years of education between the CAPD and healthy elderly groups. The CAPD group had a higher monthly income than the healthy group ($p = 0.029$). Most subjects in both study groups lived with their families; 22.2% of CAPD patients lived in old age homes but only 1.5% of healthy elderly lived in old age homes ($p < 0.001$). In contrast, 2.5% of CAPD patients and 27.3% of healthy subjects lived alone (Table 1).

The CMMSE scores were significantly different in the CAPD ($n = 81$; median, 25; interquartile range, IQR, 19.5–27.5) and healthy elderly groups ($n = 66$; median, 27.5; IQR, 24.75–29; $p < 0.001$; Figure 1). Thirty-one subjects (21.1%) had cognitive impairment according to the CMMSE score cutoff points. Of these, 26 (32.1%) subjects were in the CAPD group and five (7.6%) were in the healthy elderly group ($p < 0.001$) (Table 1).

Risk factors for cognitive impairment

To determine the effects of normal aging and chronic illness-induced secondary aging on cognitive function, a more detailed association between age and cognitive function was determined separately in the CAPD and the healthy elderly groups. Age was significantly correlated with CMMSE score in the healthy elderly group ($p = 0.047$) but not in the CAPD group ($p = 0.175$) (Table 2). This suggests that advancing age is a major determinant of cognitive decline in healthy elderly. Years of education was significantly correlated with CMMSE score in both the CAPD ($p = 0.001$) and healthy elderly groups ($p = 0.001$). A higher educational level was associated with a higher CMMSE score (Table 2). The difference in CMMSE score between female ($n = 75$) and male subjects ($n = 72$) was significant ($p < 0.001$); females (median, 23; IQR, 19–27) scored lower than males (median, 27.5; IQR, 26–29) (Figure 2). Twenty-four females and seven males had cognitive impairment ($p < 0.001$). Of these, 21 females were in the CAPD group (Table 3). Interestingly, there was a significant difference in the years of education ($p < 0.001$) between male ($n = 72$; mean \pm SD, 5.65 \pm 3.94;

Table 1. Demographic distribution and level of cognitive function in continuous ambulatory peritoneal dialysis (CAPD) and healthy elderly groups.

| | CAPD ($n = 81$) | Healthy ($n = 66$) | p |
|--|-------------------|----------------------|-----------|
| Mean age \pm SD (yr) | 71.59 \pm 4.23 | 71.77 \pm 5.59 | 0.829* |
| Female gender, n (%) | 40 (49.4) | 35 (53.0) | 0.660† |
| Mean years of education \pm SD | 3.77 \pm 3.72 | 4.85 \pm 4.19 | 0.099* |
| Level of cognitive function | | | < 0.001†‡ |
| Normal (%) | 55 (67.9) | 61 (92.4) | |
| Impaired (%) | 26 (32.1) | 5 (7.6) | |
| Marital status, n (%) | | | 0.112† |
| Married | 74 (91.4) | 54 (81.8) | |
| Never married | 1 (1.2) | 5 (7.6) | |
| Separated (inc. widows, widowers, divorcees) | 6 (7.4) | 7 (10.6) | |
| Monthly family income, n (%) | | | 0.029†‡ |
| On CSSA | 17 (21.0) | 19 (28.8) | |
| 0–5,000 [§] | 19 (23.5) | 24 (36.4) | |
| 5,001–10,000 [§] | 21 (25.9) | 10 (15.2) | |
| 10,001–15,000 [§] | 6 (7.4) | 8 (12.1) | |
| > 15,000 [§] | 18 (22.2) | 5 (7.6) | |
| Living arrangement, n (%) | | | < 0.001†‡ |
| With family | 61 (75.3) | 47 (71.2) | |
| Old age home | 18 (22.2) | 1 (1.5) | |
| Alone | 2 (2.5) | 18 (27.3) | |

*Independent t test; †Pearson's Chi-squared test; ‡ $p < 0.05$ (2-tailed); §Hong Kong dollars. CSSA = Comprehensive Social Security Assistance.

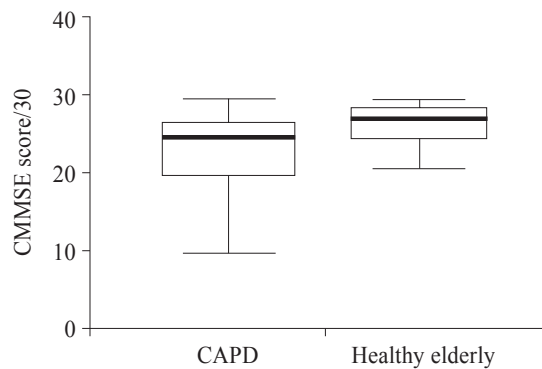


Figure 1. Box plot illustrating Cantonese version of the Mini-Mental State Examination (CMMSE) scores in the continuous ambulatory peritoneal dialysis (CAPD) and healthy elderly groups. In the CAPD group ($n = 81$), median score is 25 and interquartile range (IQR) is 19.5–27.5; distribution is severely negatively skewed (-1.068) and there are three minor outliers, one with a score of 5 and two with scores of 8. In the healthy elderly group ($n = 66$), median score is 27.5 and IQR is 24.75–29; distribution is severely negatively skewed (-1.086) and there are two minor outliers with scores of 17. CMMSE scores in the two groups differed significantly ($p < 0.001$, Mann-Whitney U test).

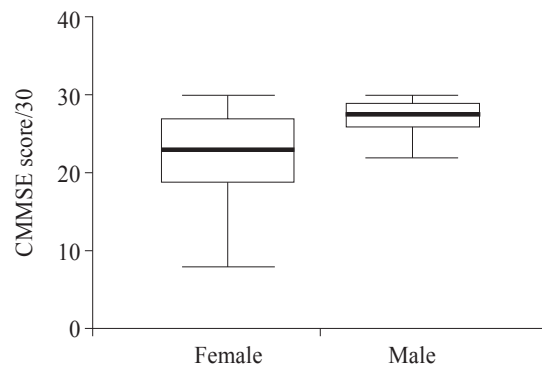


Figure 2. Box plot illustrating differences in Cantonese version of the Mini-Mental State Examination (CMMSE) scores between female and male participants. In females ($n = 75$), median score is 23, interquartile range (IQR) is 19–27 and skewedness is -0.704 . In males ($n = 72$), median score is 27.5, IQR is 26–29 and skewedness is -2.866 . CMMSE scores in male and female subjects differed significantly ($p < 0.001$, Mann-Whitney U test).

range, 0–20) and female ($n = 75$; mean \pm SD, 2.91 ± 3.5 ; range, 0–12) subjects.

Logistic regression showed that females were three times more at risk of cognitive impairment than males (odds ratio, OR, 3.3; 95% confidence interval, 95% CI, 1.1–9.9; $p < 0.03$). Every additional year increase in age increased the odds of having cognitive impairment by 1.1 times (OR, 1.1; 95% CI, 1.02–1.3; $p = 0.018$).

Education, however, seemed to be a protective factor. Every additional year increment in education decreased the odds of having cognitive impairment by 0.78 times (OR, 0.78; 95% CI, 0.65–0.94; $p < 0.009$). After adjusting for the effects of gender, age and years of education, elderly CAPD patients were 7.7 times more likely to have cognitive impairment than the healthy elderly (OR, 7.7; 95% CI, 2.4–24.8; $p < 0.001$).

Table 2. Means \pm standard deviations of predictor variables and correlation coefficients with Cantonese version of the Mini-Mental State Examination (CMMSE) score.

| | Mean \pm SD | Correlation with CMMSE score, r | p |
|-------------------------------|------------------|-----------------------------------|----------|
| Age (yr) | | | |
| CAPD ($n = 81$) | 71.59 \pm 4.23 | -0.152 | 0.175 |
| Healthy elderly ($n = 66$) | 71.77 \pm 5.59 | -0.245 | 0.047* |
| Years of education | | | |
| CAPD | 3.77 \pm 3.72 | 0.521 | < 0.001* |
| Healthy elderly | 4.85 \pm 4.19 | 0.553 | < 0.001* |
| CAPD group only | | | |
| Kt/V | 1.8 \pm 0.38 | 0.034 | 0.762 |
| Albumin, g/L | 31.2 \pm 3.5 | 0.170 | 0.130 |
| Hemoglobin, g/dL | 8.8 \pm 1.43 | -0.053 | 0.639 |
| Duration of dialysis (mo) | 36.4 \pm 29.3 | -0.070 | 0.532 |
| Number of comorbid conditions | 2.83 \pm 1.37 | -0.047 | 0.675 |

*Pearson's correlation significant at 0.05 (2-tailed). CAPD = continuous ambulatory peritoneal dialysis; Kt/V = dialysis adequacy index.

Univariate descriptive analysis of clinical and social characteristics in the CAPD group

The level of dependence ($p < 0.001$), type of care ($p < 0.001$), and the living arrangements ($p < 0.04$) were significantly different between the cognitively impaired ($n = 26$) and cognitively normal participants ($n = 55$) in the CAPD group (Table 3).

About 80% of cognitively impaired and 36% of cognitively normal CAPD patients were partially dependent or totally dependent on others. Five cognitively impaired patients claimed they were independent at the time of the cognitive assessment; 92.3% of cognitively impaired and 52.7% of cognitively normal CAPD patients required helpers to perform their dialysis exchange. About 61.5% of cognitively impaired CAPD patients lived with their families and the rest resided in old age homes; none lived alone. Elderly CAPD patients with normal cognitive function (14.5%) residing in old age homes were probably too fragile in physical health to manage their complex dialysis therapy.

Association between CMMSE score, predictor variables and health care outcomes in the CAPD group

Years of education was the only variable that had a significant correlation with CMMSE score in the CAPD group ($r = 0.521$). All other predictor variables, including adequacy of dialysis, duration of dialysis, and hemoglobin and albumin levels, did not reach a significant correlation with CMMSE score (Table 2).

A significant inverse correlation was found between CMMSE score and length of hospitalization (days) ($r = -0.243$); patients with more days of hospitalization had lower CMMSE scores. Length of hospitalization was also positively correlated with episodes of peritonitis ($r = 0.464$) and inversely correlated with albumin level ($r = -0.361$). Moreover, peritonitis (episodes) was inversely correlated with albumin levels ($r = -0.305$) (Table 4).

Of dialysis participants, 96.3% had a history of hypertension, 51.9% were diabetic, 42% had ischemic heart disease, 18.5% had a history of cerebral vascular accidents, 27.2% had a history of CHD, 13.6% were positive for hepatitis B, and 6.2% were positive for hepatitis C. A history of thyroid disease was found in 13.6% of subjects, while 1.2% of subjects had peripheral vascular disease and 1.2% had a history of psychiatric illnesses. CHD was the only comorbid medical condition that was significantly different between cognitively impaired and normal CAPD participants ($p = 0.034$) (Table 5).

DISCUSSION

The high prevalence of cognitive impairment in elderly CAPD patients (32%) deserves attention in the dialysis community. Decline in cognitive function is associated with aging [9]. Physical health and the presence of comorbid medical conditions are also key moderators

Table 3. Personal and social characteristics in the continuous ambulatory peritoneal dialysis (CAPD) group ($n = 81$) by level of cognitive function.

| | Normal ($n = 55$) | Impaired ($n = 26$) | p |
|----------------------------------|---------------------|-----------------------|-----------------------|
| Mean age \pm SD | 71.2 \pm 4.23 | 72.42 \pm 4.2 | 0.227* |
| Female gender, n (%) | 19 (34.5) | 21 (80.8) | < 0.001 ^{†‡} |
| Mean years of education \pm SD | 4.67 \pm 3.81 | 1.85 \pm 2.68 | < 0.001* [‡] |
| Type of care provider, n (%) | | | < 0.001 ^{†‡} |
| Self-care | 26 (47.3) | 2 (7.7) | |
| Helper | 29 (52.7) | 24 (92.3) | |
| Living arrangement, n (%) | | | 0.04 ^{†‡} |
| With family | 45 (81.8) | 16 (61.5) | |
| Old age home | 8 (14.5) | 10 (38.5) | |
| Alone | 2 (3.6) | 0 (0) | |
| Level of dependence, n (%) | | | < 0.001 ^{†‡} |
| Independent | 35 (63.6) | 5 (19.2) | |
| Partially dependent | 19 (34.5) | 11 (42.3) | |
| Dependent | 1 (1.8) | 10 (38.5) | |

*Independent t test; [†]Pearson's Chi-squared test; [‡] $p < 0.05$ (2-tailed).

Table 4. Correlation between the Cantonese version of the Mini-Mental State Examination (CMMSE) score and health care outcomes in the continuous ambulatory peritoneal dialysis (CAPD) group ($n = 81$).

| | CMMSE | Length of hospitalization (d) | Peritonitis (episodes) | Exit site infection (episodes) | Albumin level |
|--------------------------------|-------|-------------------------------|------------------------|--------------------------------|---------------------|
| CMMSE | 1.000 | -0.243* | -0.124 | -0.066 | 0.170 |
| Length of hospitalization (d) | | | 0.464 [†] | -0.011 | -0.361 [†] |
| Peritonitis (episodes) | | | | 0.134 | -0.305 [†] |
| Exit site infection (episodes) | | | | 0.066 | |
| Albumin level | | | | | 1.000 |

*Pearson's correlation significant at 0.05 (2-tailed); [†]Pearson's correlation significant at 0.01 (2-tailed).

Table 5. Distribution of comorbid medical conditions in the continuous ambulatory peritoneal dialysis (CAPD) group by level of cognitive function.

| | Level of cognitive function ($n = 81$) | | p^* |
|---|--|-----------------------|--------------------|
| | Normal ($n = 55$) | Impaired ($n = 26$) | |
| History of DM ($n = 42, 51.9\%$) | 27 | 15 | 0.487 |
| History of HT ($n = 78, 96.3\%$) | 53 | 25 | 1.0 |
| History of CVA ($n = 15, 18.5\%$) | 7 | 8 | 0.068 |
| History of PVD ($n = 1, 1.2\%$) | 1 | | 1.0 |
| History of CHD ($n = 22, 27.2\%$) | 19 | 3 | 0.034 [†] |
| History of IHD ($n = 34, 42\%$) | 24 | 10 | 0.810 |
| HbsAg +ve ($n = 11, 13.6\%$) | 8 | 3 | 1.0 |
| Anti-HCV +ve ($n = 5, 6.2\%$) | 4 | 1 | 1.0 |
| History of thyroid disease ($n = 11, 13.6\%$) | 8 | 3 | 1.0 |
| History of psychiatric illness ($n = 1, 1.2\%$) | 1 | | 1.0 |

*Fisher's exact test; [†] $p < 0.05$ (2-tailed). DM = diabetes mellitus; HT = hypertension; CVA = cerebral vascular accident; PVD = peripheral vascular disease; CHD = coronary heart disease; IHD = ischemic heart disease; HbsAg +ve = hepatitis B antigen positive; anti-HCV +ve = positive for antibody to hepatitis C virus.

influencing cognitive aging [10]. Illness, malnutrition and trauma play important roles in degenerative changes [11]. There are significant associations between cognitive decline and medical conditions such as hypertension, stroke, ESRD and diabetes [12–17]. Thus, normal aging may not be the only major determinant, but premature secondary aging induced by chronic illnesses may also be responsible for, or contribute to, cognitive impairment.

Badzek et al found that 39% of 142 elderly ESRD hemodialysis patients had diminished cognitive capacity [18], and Sehgal et al demonstrated that 30% of 336 randomly selected chronic hemodialysis patients were cognitively impaired [12]. However, it is hard to conclude that Hong Kong Chinese CAPD patients have a similar rate of incidence as their counterparts in other countries. The above study included subjects with a mean age of 59 years [12], while the mean age in our CAPD study group was 72 years. A local survey found that 25% of Hong Kong people aged 60 years and above had mild to severe cognitive impairment [19]. Hong Kong studies on mental health status in the dialysis

community are lacking. The information regarding cognitive competency among dialysis patients appears to be inadequate.

Increase in years of education decreased the odds of having cognitive impairment in the present study. However, the association of lower education with poorer cognitive function is not consistent across studies [20–23]. The Leiden 85-plus Study found that participants with lower levels of education had poorer scores on neuropsychologic tests ($p < 0.001$) [22]. However, education had no detectable effect on cognitive outcome in a meta-analysis conducted by McNeal et al [23].

Advancing age is associated with cognitive decline and females are at three times the risk of males of suffering from cognitive impairment. This finding is congruent with other studies [23–27]. Low literacy among female subjects in the present study could probably explain this phenomenon.

CHD was the only comorbid condition that showed a statistical significance with cognitive impairment. A previous study also showed an association between

CHD and an increased risk of Alzheimer's disease [28]. In the present study, many CAPD subjects had multiple comorbid conditions and these medical diseases were not mutually exclusive. The mechanisms linking CHD to cognitive impairment require further study.

There was a significant inverse correlation between CMMSE score and length of hospitalization, which was consistent with other studies [12,29]. A local study also concluded that poor mental state was one determinant for residential care and for residency in a medical infirmary [30].

Although Sehgal et al found that poorer nutritional status was associated with mild to severe cognitive impairment [12], this claim was not supported by the present study as the albumin level was inversely correlated with hospital stay only, but had no significant correlation with CMMSE score.

Of the cognitively impaired CAPD patients, 92% required helpers for their dialysis exchange; 61.5% of these patients lived with their families. High stress levels are found among care providers of cognitively impaired elderly [31]. Health care professionals must address the difficulties of caring for these patients. Information regarding care resources, social support, and the consequences of cognitive decline might be helpful for families and patients to deal with their problems and plan for the future. Moreover, 22.2% of CAPD participants lived in old age homes. Outreach nursing teams that regularly audit and monitor the dialysis practice in these institutional care settings are crucial to enhance quality assurance. Lastly, an advance directive bearing the patient's decision about terminal care is useful to cognitively impaired patients for when they lose the ability to communicate. However, it is uncommon to prepare an advance directive in Chinese culture, which traditionally regards this as offensive to the elderly. The concept is new in the dialysis community but is an important medico-legal issue to be addressed in future.

Dialysis participants were recruited from the renal unit of a major hospital where patients might have been more physically unstable than patients cared for in community settings, as patients with fewer comorbidities are referred to satellite centers for follow-up. Therefore, the reported prevalence of cognitive impairment in this study might have been substantially overstated due to the generally poorer physical condition of participants.

Depression may have an effect on cognitive performance; the design of this study did not include an objective assessment to detect depression. The principal investigator assessed participants by observing signs and symptoms of depression only. Depression may have been missed in some participants.

Dialysis adequacy and hemoglobin and albumin levels were not significantly correlated with CMMSE

score in this study. It is possible that the CMMSE may not be sensitive enough to detect cognitive changes resulting from uremic, anemic and malnutrition states. This study did not determine whether cognitive impairment among CAPD patients led to poorer health outcomes or vice versa. The direction of causality of these conditions remains unknown.

With diminished cognitive capacity, patients are prone to lose their ability to process and recall information [18]. Periodic monitoring of cognitive function will provide valuable information about the trend of changes. Incorporating a full-scale cognitive screening test such as the CMMSE into nursing assessment is vital to determine the cognitive capacity for self-care CAPD therapy. Of CAPD subjects, 32% had cognitive impairment. The present study suggests that female CAPD patients older than 65 years who have low literacy are at high risk of cognitive impairment.

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