Continuous Ambulatory Peritoneal Dialysis: Experience with 22 Unselected Patients with Renal Failure

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The present study describes our experience with CAPD in an unselected group of patients presenting with endstage renal failure. Twenty-three consecutive patients were offered CAPD, in-center, and home hemodialysis. Twenty-two patients selected CAPD, including 14 patients more than 60 years of age, four patients with diabetes, and one with multiple myeloma. CAPD training was performed in an out-of-hospital office facility. One patient returned to hemodialysis following the development of resistant Pseudomonas peritonitis, two patients died of a myocardial infarction, and one patient died with a GI bleed. The other 18 patients are doing well. Assessment of 17 patients maintained on therapy for four months or more revealed that the patients are less depressed, less organic, and have fewer physical symptoms than previously reported for a comparable group of patients maintained on hemodialysis for a similar period of time. In conclusion, CAPD can be successfully employed, at least for the initial months of therapy, to treat the vast majority of patients with endstage renal disease. CAPD training and follow-up care can be provided in an out-of-hospital office facility.

INTRODUCTION

Continuous ambulatory peritoneal dialysis (CAPD) was recognized as a practical treatment modality for patients with endstage renal disease (ESRD) in 1978 [1–3]. During the past two years, refinements in the technical aspects of the procedure have expanded the potential patient population for whom CAPD is now a viable therapeutic option [4–6]. At the present time, however, it remains unclear what percentage of the population with ESRD can be seriously considered as candidates for CAPD. While some investigators feel that only 15 to 20 percent of ESRD patients can be trained for CAPD [4], others feel that the majority can be maintained on this therapy [5].

During the past 15 months we have had an unique experience with CAPD in the management of patients with renal failure. All patients presenting to our group with ESRD were offered CAPD therapy or hemodialysis in the nearest outlying facility with available resources, because of the lack of available hemodialysis facilities in New Haven. The lack of long-term experience with CAPD as a therapeutic alternative was carefully explained to 23 consecutive patients. Nevertheless 22 patients elected CAPD while only one elected to receive hemodialysis treatments. No patients were refused CAPD training. Because of the lack of available hospital resources, a CAPD training facility was established in a specially designated area of a physician's office adjacent to, but physically separate from, the hospital-based dialysis facility.
The present paper details our experience with this unselected group of 22 patients with ESRD who received their CAPD training in an out-of-hospital, office facility.

METHODS

During the past 15 months all new patients with ESRD (defined by the presence of uremic symptoms and a creatinine clearance < 8 cc/min) were offered CAPD, home hemodialysis, or in-center hemodialysis as therapeutic options. In-center hemodialysis treatments would have to be obtained by these patients at a distance of 25 to 70 miles from their homes because no places were available in the hemodialysis units in New Haven. Although the potential risks of CAPD were fully explained, 22 patients with ESRD elected CAPD; one elected in-center hemodialysis and none home hemodialysis. No patients with ESRD were refused CAPD training.

All patients were admitted to the hospital where two-cuff Tenckoff catheters were surgically inserted. Patients were then dialyzed for 36 continuous hours followed by 6- to 8-hour treatments for two or three successive days. After the last 6- to 8-hour treatment, patients were discharged from the hospital and CAPD training was begun within three to five days. Training was performed in a physician's office physically detached from the hospital, in a separate area designated for CAPD training. Training consisted of three 1 to 1 1/2 hour individual training sessions per day centered around CAPD "bag changes." Patients were given literature to read and were instructed in the basic principles and techniques involved in CAPD [1-5]. Patients were taught how to perform bag changes and give skin care of the catheter exit site and were given written instructions concerning these procedures. Training was completed within 14 days for all patients. Patients returned to the training facility on a monthly basis for connecting tube changes and physical and laboratory examinations. Each patient's techniques of performing bag exchanges and skin care were reviewed on a monthly basis. Patients were encouraged to call the training facility for any problems or difficulties that arose. Since October 1979, the new screw-lock titanium adapter between the Tenckoff catheter and connecting tube has been used [6].

Treatment consisted of four exchanges per day, seven days per week, using 2,000 cc plastic bags of standard peritoneal dialysate (Travenol). 1.5 percent dextrose dialysate was used for most exchanges; 4.25 percent dextrose dialysate was used as needed to remove excess fluid. Peritonitis was diagnosed by the development of cloudy fluid associated with abdominal pain and positive peritoneal fluid cultures. Therapy consisted of the institution of intraperitoneal antibiotics, as previously described [6]. Cephalothin (250 mg per 2-liter exchange) was the initial antibiotic used. The number of bag exchanges was increased to six per day until clearing of peritoneal fluid occurred. Cultures of peritoneal fluid were obtained on all patients prior to the start of antibiotic therapy and treatment adjusted depending on the organism identified. Peritonitis was treated out of hospital; patients were hospitalized only if they were unable to perform the treatment at home.

Careful and thorough dietary instruction was given to all patients. Patients were encouraged to eat a minimum of 80 to 100 grams of protein and a maximum of 1,500 to 2,000 calories per day, with 30-35 percent of the calories in the form of carbohydrates.

The overall functional and psychological status of the CAPD patients was assessed, utilizing standardized evaluation procedures previously employed by us in the assessment of a large cohort of home and in-center hemodialysis patients [8-10]. Only those patients maintained on CAPD for four or more months were examined.
and comparisons were made with patients maintained on hemodialysis for three to twelve months. The data on the hemodialysis patients is compiled from information previously obtained [8]. Patients completed two forced-choice questionnaires of the Kupfer-Detre Systems (KDS). The KDS-1 form evaluates current psychological status using 41 questions covering a variety of psychological and neurovegetative symptoms. The KDS-2 form elicits data on presence or absence of 64 specific physical symptoms. The scoring, standardization, and utility of the questionnaires are well documented both in healthy controls and in dialysis patients [8–13].

All data are expressed as mean ± SEM and statistical comparisons are made with student’s “t” test or “T” test for proportions.

RESULTS

The 22 patients trained for CAPD are listed in Table 1. Eighteen of these patients remain at home and are doing well. Three patients have died. One patient changed to hemodialysis after her peritoneal catheter was removed to facilitate the cure of a resistant pseudomonas peritonitis. Of particular note is the fact that 14 of the 22 patients are ≥60 years of age and five of the patients are over age 70. Five of the 14 patients ≥60 years of age are unmarried and live alone. Training these older patients to perform CAPD has not presented any major difficulties, although three patients require visiting nurse assistance to perform skin care.

The etiology of the renal failure in our CAPD patients is similar to that reported in larger series of patients with ESRD [8]. Included in the present series are three patients with diabetic nephropathy, one with multiple myeloma, and one with biopsy proven cholesterol embolization.

The incidence of peritonitis, one infection per seven patient-months, is similar to that reported in other series of CAPD patients [4–6]. There was not a statistically significant greater incidence of infection in the patients ≥60 years of age, or in the patients with diabetic nephropathy.

Only seven of the patients have required hospitalization for a total of 57 days after the initial insertion of their peritoneal catheters. Patients 2, 4, and 8 were hospitalized for a total of 21 days for treatment of peritonitis; patient 11 was hospitalized for replacement of his peritoneal catheter, and patient 1 was hospitalized for pneumonia. Patients 13 and 18 were hospitalized preterminally with a gastrointestinal bleed and an acute myocardial infarction, respectively.

The psychological status of the CAPD patients maintained on therapy for ≥4 months (patients 1–17) was compared to a group of hemodialysis patients maintained on therapy for a similar period of time (Table 2). While the hemodialysis patients had a mean depression score on the KDS-1 form, 7.5 ± 0.3, comparable to that of patients seeking help in an outpatient psychiatric clinic, 7.6 ± 0.4 [12] CAPD patients had significantly lower scores 3.0 ± 0.5 (p<0.01). Previous use of this questionnaire with psychiatric outpatients indicated that scores ≥10 on the depression scale reflected severe depressive symptomatology [13]; 25 percent of the hemodialysis patients had scores in this range while none of the CAPD patients did (p<0.01).

Similarly, the CAPD patients had significantly lower organicity scores (3.1 ± 0.5) than the hemodialysis patients (5.2 ± 0.03, p<0.01). Previous studies have suggested that scores of six or greater are associated with clinical evidence of substantial organic brain dysfunction [11]. While 40 percent of the hemodialysis patients had scores over six, only seven percent of the CAPD patients did (p<0.01).

The mean score of the hemodialysis patients, 19.1 ± 0.3 on the physical symptoms checklist (KDS-2), are significantly higher than the score of the CAPD patients
| Patient No. | Sex | Age | Diagnosis* | Marital Home Situation | Months on CAPD | Episodes Peritonitis | Comment |
|------------|-----|-----|------------|------------------------|----------------|---------------------|---------|
| 1          | M   | 38  | CGN        | Married                | 14             | 3                   | Doing well |
| 2          | F   | 55  | CGN        | Married                | 13             | 3                   | Doing well |
| 3          | F   | 52  | Polycystic | Single—lives alone    | 12             | 1                   | Doing well |
| 4          | F   | 65  | Diabetes   | Widow—lives with daughter | 11             | 3                   | Doing well |
| 5          | M   | 69  | Polycystic | Married                | 11             | 0                   | Doing well |
| 6          | M   | 35  | CGN        | Married                | 10             | 2                   | Doing well |
| 7          | F   | 62  | RVT        | Married                | 10             | 1                   | Doing well |
| 8          | M   | 63  | CGN        | Single—lives alone    | 9              | 3                   | Doing well |
| 9          | F   | 65  | CIN        | Married                | 9              | 0                   | Doing well |
| 10         | M   | 73  | CGN        | Single—lives alone    | 9              | 0                   | Doing well |
| 11         | M   | 73  | CIN        | Single—lives alone    | 8              | 2                   | Doing well |
| 12         | M   | 41  | CGN        | Married                | 6              | 2                   | Doing well |
| 13         | F   | 69  | Myeloma    | Married                | 6              | 0                   | Died of GI bleed |
| 14         | F   | 60  | Diabetes   | Married                | 6              | 0                   | Doing well |
| 15         | F   | 49  | CIN        | Married                | 5              | 0                   | Doing well |
| 16         | F   | 60  | CGN        | Married                | 5              | 2                   | Changed to hemodialysis† |
| 17         | F   | 40  | Polycystic | Married                | 4              | 0                   | Doing well |
| 18         | F   | 63  | Diabetes   | Widow—lives with daughter | 3             | 1                   | Died of MI |
| 19         | M   | 76  | CIN        | Single—lives alone    | 3              | 0                   | Doing well |
| 20         | M   | 55  | Diabetes   | Married                | 2              | 0                   | Doing well |
| 21         | M   | 72  | Cholesterol emboli | Married        | 2              | 0                   | Died of MI |
| 22         | F   | 78  | CGN        | Single—lives alone    | 1              | 0                   | Doing well |

*CGN = chronic glomerulonephritis
RVT = renal vein thrombosis
CIN = Chronic interstitial nephritis
† = Catheter removed because of resistant Pseudomonas peritonitis

7.5 ± 1.3 (p<0.01); while 40 percent of the hemodialysis patients had scores greater than or equal to 20, only seven percent of the CAPD patients had scores in this range (p<0.01).

Monthly laboratory testing on the CAPD patients maintained on treatment for ≥4 months (patients 1–17) indicates that the mean values of the most recent BUN, creatinine, albumin, cholesterol, triglycerides, hematocrit, calcium, and phosphorus determinations are not significantly different than those reported for other groups of CAPD patients (Table 3) [6]. Since blood and plasma laboratory values may not come to equilibrium until the patients have been on treatment for six months or more [6], the mean values in the table probably do not reflect the ultimate equilibrium values.
TABLE 2
KDS Scores

| CAPD (n = 17) | Hemodialysis (n = 46) | Controls (see text)* |
|--------------|----------------------|----------------------|
| Depression Score | 3.0 ± 0.6 | 7.5 ± 0.3* | 4.1 ± 0.3[9] |
| Organicity scan | 3.1 ± 0.5 | 5.2 ± 0.3* | 1.5 ± 0.1[9] |
| Physical symptom checklist | 7.5 ± 1.3 | 19 ± 1.3* | 1.6 ± 0.4[8] |
| Mean age | 57 ± 3 | 54 ± 2 | – |

*p < 0.01 when compared to CAPD patients
*This group is not strictly comparable to the CAPD group, and is therefore not suitable for statistical comparison so the scores should be used only to indicate those obtained in normal individuals.

DISCUSSION

CAPD has recently been developed as an alternative therapy for patients with endstage renal failure [1-6]. At present, there is insufficient experience with CAPD to compare the long-term effects of this treatment modality with the more standard hemodialysis and intermittent peritoneal dialysis therapies. Initial results with CAPD, however, have been promising [1-6]. Nevertheless, it remains unclear at present what impact CAPD will have on existing ESRD health care programs.

The present study suggests that the vast majority of patients with ESRD not only can be successfully trained for CAPD but also can be successfully maintained on CAPD for at least the initial months of therapy. Thus, 22 of 23 new patients with endstage renal failure seen by our group during the last year have been treated with CAPD. The patient population treated with CAPD in the present study, including five patients more than 70 years of age, 14 patients ≥ 60 years of age, four patients with diabetes, one patient with myeloma, and six patients living alone, represents an unselected population of patients with ESRD and is typical of the more general population of patients with renal failure [8].

Patient acceptance of CAPD has been uniformly enthusiastic. No patient has requested to be cared for by an in-center hemodialysis or peritoneal dialysis program. Only one patient returned to in-center hemodialysis because of a resistant Pseudomonas peritonitis necessitating catheter removal. Patients have spent minimal time in hospital; ten patients have not required hospitalization after the placement of their peritoneal catheters. Furthermore, assessment of the patients' psychological and general physical status has been most encouraging: our CAPD patients maintained on therapy for four to 12 months had significantly less depressive and less organic symptomatology than a group of hemodialysis patients maintained on therapy for a comparable period of time. In addition the CAPD patients had significantly fewer physical symptoms than the hemodialysis patients (Table 2).

The expense of government financed programs for the treatment of patients with ESRD has been the focus of increasing attention recently [14]. In the United States,

TABLE 3
Laboratory Data* of Patients on CAPD ≥ 4 Months

| Parameter                  | Value       |
|----------------------------|-------------|
| HCT (%)                    | 28 ± 2      |
| BUN (mg/dl)                | 64 ± 6      |
| Creatinine (mg/dl)         | 9.9 ± 1.3   |
| Albumin (g/dl)             | 3.0 ± 0.1   |
| Sodium (mEq/L)             | 139 ± 1     |
| Venous Bicarbonate (mEq/L) | 26 ± 1      |
| Calcium (mg/dl)            | 9.1 ± 0.4   |
| Inorganic Phosphorus (mg/dl) | 4.9 ± 0.5 |
| Triglycerides (mg/dl)      | 232 ± 36    |
| Cholesterol (mg/dl)        | 222 ± 29    |
| Potassium (mEq/L)          | 4.2 ± 0.3   |

*mean ± SE of most current monthly laboratory studies
the ESRD program consumes 5 percent of the Medicare budget for less than 0.2 percent of the active Medicare population [14]. One problem with the United States ESRD program has been the declining percentage of patients with endstage renal failure treated with home dialysis [14]. In European countries, continued home training has, to some extent, helped curtail the cost of endstage renal disease therapy. Maintaining a patient on CAPD at present costs about $12,000 a year, compared to $25,000 for in-center hemodialysis and about $10,000 for home hemodialysis. Since the present study suggests that the vast majority of patients with ESRD can be successfully trained and maintained on CAPD, the potential cost saving by the wide application of this therapy may be considerable.

Furthermore, the nature of our training program is of interest and has additional implications in terms of utilization of health care resources. Training and follow-up therapy for all CAPD patients in this study was provided in a physician-office setting, with hospital beds being used only for the placement of peritoneal catheters and for severe complications arising during therapy. The advantages of this type of program include an efficient utilization of personnel and health care resources, encouragement of patient independence by distancing them from the hospital, and provision for more flexibility in training schedules. It must be stressed, however, that for such an office-based program to be successful, rigorous and thorough care and follow-up must be provided by dedicated and concerned nurse and physician staffs, available 24 hours a day, seven days a week. In addition, full hospital support with an adequate number of hospital nurses skilled in peritoneal dialysis techniques must be available to back up the out-of-hospital facility.

In summary, CAPD can be successfully employed, at least for the initial months of therapy, to treat the vast majority of patients with ESRD. CAPD training and follow-up care can be provided in an out-of-hospital office facility, if adequate hospital support is available and the facility is staffed by conscientious personnel.

REFERENCES
1. Popovich RP, Moncrief JW, Nolph KD, et al: Continuous ambulatory peritoneal dialysis. Ann Int Med 88:449, 1978
2. Oreopoulos DG, Robson M, Izatt S, et al: A simple and safe technique for continuous ambulatory peritoneal dialysis (CAPD). Trans Am Soc Artif Intern Organs 24:484, 1978
3. Moncrief JW, Popovich RP, Rubin J, et al: Additional experience with continuous ambulatory peritoneal dialysis (CAPD). Trans Am Soc Artif Intern Organs 24:476, 1978
4. Moncrief, JW: Continuous ambulatory peritoneal dialysis. Dialysis and Transplantation 8:1077, 1979
5. Oreopoulos DG, Clayton S, Dombros N, et al: Experience with continuous ambulatory peritoneal dialysis. Abst Am Soc Artif Int Organs 8:51, 1979
6. Nolph KD, Sorkim M, Rubins J, et al: Continuous ambulatory peritoneal dialysis: Three year experience at one center. Ann Int Med 92:609, 1980
7. Black HR, Finkelstein FO, Lee R: The treatment of peritonitis in patients with chronic indwelling catheters. Trans Am Soc Artif Intern Organs 20:115, 1974
8. Bonney S, Finkelstein FO, Lytton B, et al: Treatment of end-stage renal failure in a defined geographic area. Arch Intern Med 138:1510, 1978
9. Finkelstein FO, Finkelstein SH, Steele TE: Assessment of marital relationships of hemodialysis patients. Am J Med Sci 271:21, 1976
10. Finkelstein FO, Steele TE: Sexual dysfunction and chronic renal failure. Dialysis and Transplantation 7:877, 1978
11. Kupfer OJ, Detre TP: KDS-1 Scale for symptom discrimination. Psychol Rep 20:915, 1972
12. Steele TE, Myerson MW, Kupfer DJ: Treatment recommendation for psychiatric outpatients. Soc Psychiatry 7:180, 1972
13. Kupfer DJ, Detre TP: Development and application for the KDS-1 in inpatient and outpatient settings. Psychol Rep 29:607, 1971
14. Blagg CR, Scribner BH: Longterm dialysis: Current problems and future prospects. Amer J Med 68:633, 1980